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Transition to a circular economy – the intersection of business and user enablement

Producenters och konsumenters samverkan för cirkulär ekonomi

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Abstract

In light of increased environmental destruction, resource scarcity and increased waste production the concept of circular economy has gained attention. The aim of this work is to give an insight into the perspectives of businesses and consumers in a circular economy (CE). A systematic literature review is conducted to understand the role of the players within a CE as well as the barriers existing when implementing a circular economy to replace a predominantly linear economic system. An illustrative case study is used as a practical supplement and concrete example of business consumer interaction. The novelty of this study lies in the direct comparison and linkage of businesses and users in a CE.

By applying sustainable product design, closing resource loops, implementing service solutions or circularity along their supply chain businesses can move towards circular business models. The barriers businesses face during this process can be of governmental, economical, technological, knowledge and skill, management, infrastructural, culture and social, and market related nature. The illustrative case added the issue of finding the right people to work with to the business barriers. Consumers are key enablers for CE and can actively participate using alternative consumption models such as collaborative, second-hand or access-based consumption. Due to the change in consumption that needs to occur in a CE, consumers also face implementation barriers related to product use, knowledge, infrastructure, economic and attitude.

This work concludes that there is a considerable overlap of barriers between businesses and users, who act and interact in many ways along the supply loops. The conflicts of interest occur along the supply loops regarding waste management and the related infrastructure, expected and realised product prices, quality demands and the need for circular product design. The illustrative case shows that a positive relationship and close interaction in the transition phase to CE is possible. However, this work deduces that the barriers for businesses and consumers persist.

Overall, this study contributes to the holistic understanding of the circular economy and two major stakeholders in it. It can be a foundation for further research which could include consumer and user surveys and interviews regarding consumer behaviour, demand, perceived obstacles and understanding of CE.

Key words: *barriers, closed loop system, consumer, EU waste directive, sustainable design, sustainable business models, waste management*

Sammanfattning

Begreppet cirkulär ekonomi har fått ökad uppmärksamhet i ljuset av insikter om miljöförstörelse, begränsade och ändliga resurser samt ökade volymer av sopor. Det här projektet syftar till att förklara hur ett cirkulärt ekonomisystem (CE) ter sig ur ett produktions- och användarperspektiv. En systematisk litteraturgenomgång har genomförts för att förstå hur roller för olika intressenter och vilka hinder i en förändringsprocess som påverkar förändringen från linjära ekonomiska system till cirkulära ekonomiska system. En fallillustration utgör ett praktiskt empiriskt exempel på företags- och konsumentinteraktion. Projektets bidrag är att förklara förutsättningar för förändring till en CE för såväl producenter som användare.

Genom att tillämpa avfallshierarkins principer i praktiskt arbete, till exempel hållbar produktdesign, slutna resurssystem och servicelösningar sluts värdekedjan gradvis mot en cirkulär ekonomimodell. De i litteraturgenomgången identifierade utmaningarna för en förändring mot cirkulär ekonomi är många och av olika slag kopplade till lagar, ekonomi, teknik, kunskap, färdigheter, ledarskap, infrastruktur, kultur, sociala aspekter samt marknadsförutsättningar. Fallillustrationen pekar på vikten av att identifiera rätt individer för att arbeta med barriärerna. Konsumenter ses som en förutsättning för CE-utvecklingen. Deras konsumtionsval påverkar marknadsutvecklingen för alternativa företagsmodeller, som bygger på samverkan, förlängd livscykel för produkter och ökad tillgång till produkter för ett större antal konsumenter. Konsumenterna å sin sida möter också hinder i förändring av konsumtionsmönster som är kopplade till produktanvändning, kunskap, attityd, infrastruktur och ekonomiska faktorer.

Den här studien klargör delade utmaningar för företag och konsumenter som aktivt interagerar med varandra i en cirkulär ekonomi. Intressekonflikter uppstår i värdekedjan som handlar om resurshantering, infrastruktur för materiella flöden, förväntade och realiserade priser, kvalitetsuppfattningar och behovet av cirkulär produktdesign. Det illustrerade fallet pekar dock på att i en nära relation mellan olika parter i det cirkulära ekonomisystemet kan öppna upp för nya sätt att lösa utmaningarna i en förändringsfas. Barriärerna för en systemförändring kvarstår dock.

Bidraget i studien är en övergripande förståelse för vad som rapporteras i litteraturen om utmaningar som är förknippade med en övergång till en cirkulär ekonomi för två centrala intressentgrupper, producenter och konsumenter. Studien kan utgöra en startpunkt för fortsatt forskning om konsumentbeteende. Ansatser som använder enkäter och intervjuer för att klargöra efterfrågan, upplevda hinder och upplevelse av CE skulle kunna vara ett nästa steg för att öka förståelsen för en mer hållbar konsumtion.

Nyckelord: *barriärer, EU-avfallsdirektiv, företagsmodell, hållbar utveckling, resursförvaltning, slutna system, återvinning*

Zusammenfassung

Das Konzept der Kreislaufwirtschaft, Circular Economy (CE), hat angesichts zunehmender Umweltzerstörung, Ressourcenverknappung und zunehmender Abfallmengen immer mehr Beachtung gefunden. Diese Arbeit soll erläutern, wie ein Circular Economy System aus Sicht der Unternehmen und der Nutzer aussehen kann. Es wurde eine systematische Literaturrecherche durchgeführt, um die Rolle der Akteure innerhalb einer CE sowie die Hindernisse bei deren Einführung als Ersatz für ein dominant lineares Wirtschaftssystem zu verstehen. Eine Fallstudie wird als ein praktisches, empirisches Beispiel für die Interaktion zwischen Unternehmen und Verbrauchern genutzt. Der Beitrag dieser Arbeit besteht darin, die Bedingungen für den Wechsel zu einer CE sowohl für Hersteller als auch für Anwender zu erläutern, zu vergleichen und zu verknüpfen.

Eine Wertschöpfungskette kann schrittweise zu einem Kreislaufmodell werden, indem beispielsweise nachhaltiges Produktdesign, geschlossene Ressourcensysteme und Servicelösungen in der Praxis Anwendung finden. Die in der Literaturrecherche identifizierten Herausforderungen für einen Wandel in Richtung CE sind vielfältig und können von staatlicher, wirtschaftlicher, technologischer, fachlicher, verwaltungstechnischer, infrastruktureller, kultureller und sozialer sowie marktbezogener Natur sein. Die Fallstudie zeigt, wie wichtig es ist, die richtigen Personen zu identifizieren, um mit den Barrieren umgehen zu können und eine CE umsetzen zu können. Verbraucher werden als wichtige Voraussetzung für die CE-Entwicklung gesehen. Ihre Konsumentscheidungen wirken sich auf die Marktentwicklung für alternative Geschäftsmodelle aus, die auf Zusammenarbeit, einem verlängerten Produktlebenszyklus und einem verbesserten Zugang einer größeren Anzahl von Verbrauchern zu Produkten beruhen. Aufgrund der Veränderung des Konsumverhaltens, die in einer CE auftreten muss, sind Verbraucher auch mit Umsetzungshindernissen in Bezug auf Produktnutzung, Wissen, Infrastruktur, Wirtschaftlichkeit und Einstellung konfrontiert.

Diese Arbeit verdeutlicht die gemeinsamen Herausforderungen für Unternehmen und Verbraucher, die in einer Circular Economy aktiv miteinander interagieren. Interessenkonflikte entstehen in der Wertschöpfungskette, die sich mit Ressourcenmanagement, Materialflussinfrastruktur, erwarteten und realisierten Preisen, Qualitätswahrnehmungen und der Notwendigkeit einer nachhaltigen Produktgestaltung befasst. Der dargestellte Fall weist jedoch darauf hin, dass in einer engen Beziehung zwischen verschiedenen Parteien des CE- Systems neue Wege eröffnet werden können, um die Herausforderungen in einer Phase des Wandels zu lösen. Die Hindernisse für einen Systemwechsel bleiben jedoch bestehen.

Der wissenschaftliche Beitrag dieser Arbeit ist ein umfassendes Verständnis dessen, was in der Literatur über Herausforderungen im Zusammenhang mit dem Übergang zu einer CE für zwei wichtige Interessengruppen, Hersteller und Verbraucher, berichtet wird. Die Studie kann ein Ausgangspunkt für weitere Untersuchungen zum Verbraucherverhalten sein. Ansätze, die Umfragen und Interviews umfassen, um die Nachfrage, die wahrgenommenen Hindernisse und die Erfahrung mit CE zu klären, könnten der nächste Schritt sein, um das Verständnis für einen nachhaltigeren Konsum zu verbessern.

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Abbreviations

3R	Reduce, Reuse, Recycle
4R	Reduce, Reuse, Recycle and Recover
9R	(Refuse), Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover
C.A.R.M.E.N.	Centrales Agrar-Rohstoff Marketing- und Energie-Netzwerk
CE	Circular Economy
EMF	Ellen MacArthur Foundation
EPR	Extended Producers Principle
EU	European Union
WFD	European Commission Waste Framework Directive

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1 Introduction

This chapter outlines the problem background and the problem that this work addresses. Furthermore, the aim, research questions and the structure of the thesis are presented.

1.1 Problem and background

The 29th July 2019 marked an important date: It was the "Earth Overshoot Day" which is the day, and the earliest ever, when humanity had used all resources the planet could renew within a year (Global Footprint Network, 2019, 2). Providing an example for the limitations and scarcity of natural resources this date also calls for action to delay this day in the future and move towards a sustainable, self-renewing society (Global Footprint Network, 2019, 1). An increasing world population, the pre-dominant resource exploitation, mass productions of goods and consequently also waste production point to a less desirable direction.

Since the industrial revolution the dominant economic model in high income countries has been a linear economy. In a linear economy a take-make-use-dispose mentality directs societal consumption behaviour. The almost inevitable fate of a product is its disposal at the end of its product life. According to Lieder & Rashid (2016 p. 37) this is explained by "disposable products with the explicit purpose of being discarded after use (planned obsolesce) heralded the era of fashion and style hence stimulating throwaway-mindset which is today known as linear consumption behaviour". This system reaches the limits of its capacity. A wide range of environmental problems, water and air pollution and resource depletion call for a radical change and transition to a sustainable economic system. Scarce resources will be under even more pressure as material intensity is predicted to increase with the global middle class, i.e. the largest resource demanding consumer group, doubling in size to 5 billion by 2030 (EMF 2013b). Human survival is at stake as the stability of economies is threatened together with the "integrity of natural ecosystems" (Ghisellini *et al.* 2016 p. 11). To do justice to the demanding consumers, the supplying producers but also the struggling environment a solution serving all stakeholders needs to be implemented as quickly as possible. A possible and not at all new but rather rediscovered solution can be the implementation of a circular economy (**CE**).

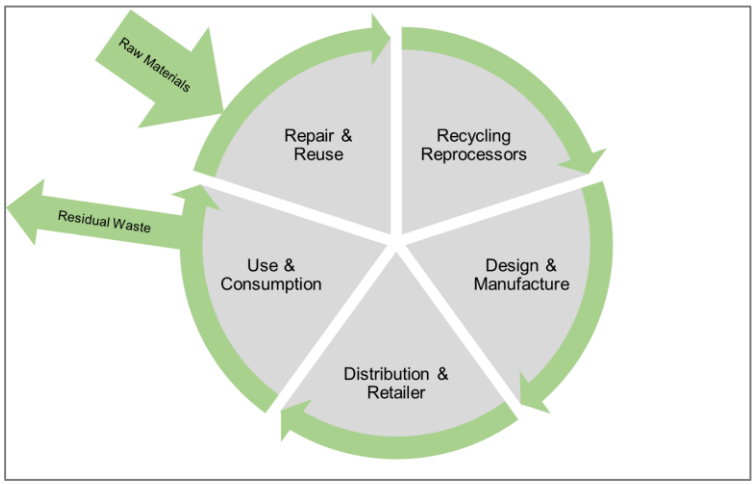

Figure 1. A circular economic system, adapted from Urbaser Group (2019, 1).

In short, CE is about creating closed loop material flows keeping "products, components and materials at their highest utility and value" (EMF 2013a) and use them through multiple phases. CE is also about waste prevention, resource efficiency, leakage minimisation and

dematerialisation (Geissdoerfer *et al.* 2017). Figure 1 depicts a principle model for a CE where raw materials are only added for manufacturing and re-manufacturing of products or components already in the system. These have been recycled or re-used by the consumer maybe several times already. Waste is almost non-existent and leaves the system as residual waste if not further used.

The shift from a predominantly linear to a circular economy needs the active involvement of many different stakeholders at several different levels. Some major enablers and also potential preventers that should be named are industries, companies or businesses, policy makers and users or consumers. Ghisellini *et al.* (2016 p. 11) accentuate their role in CE implementation as "cleaner production patterns at company level, an increase of producers and consumers responsibility and awareness, the use of renewable technologies and materials [and] the adoption of suitable, clear and stable policies and tools" are their main tasks. Companies and consumers can exert a major influence on an economy. Figure 2 shows the rapid historical and predicted growth of the middle-class from 1950 to 2030.

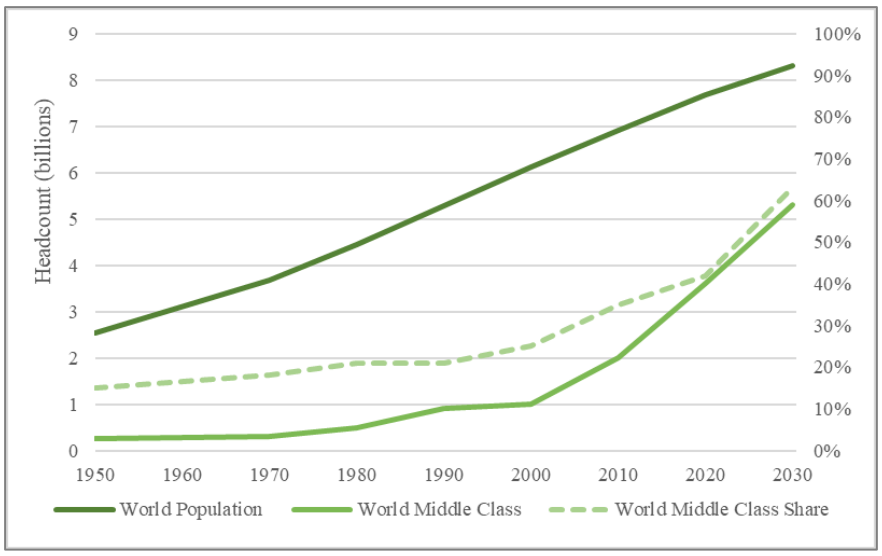

Figure 2. Estimated size of the global middle class 1950 to 2030 in billions, adapted from The Bookings Institute (2019, 1).

There is a rapid increase in the world middle class taking place since the early 2000's. With this comes an increase in purchasing power and, consequently, a shift in demand from loose, unpacked products to manufactured, packaging goods leading to higher material and waste impact (EMF 2013b).

In addition, Table 1 shows the immense power companies and businesses wield in the global economy. It is shown that 50 % of the world's 50 largest economies in revenue generation in US$ in 2016 were corporations rather than countries (countries coloured in black, corporations coloured in red). This does not only emphasize the immense influence the companies can exercise but also the responsibility, difference and guidance companies can embody in a shift towards a more environmentally friendly and sustainable economic system. Walmart Inc., for example, had a higher yearly revenue in 2016 than countries such as Spain, Sweden or Russia.

Table 1. The world's top 50 economies, adapted from Oxfamblogs (2019, 1)

Rank	Country/Corporation	Revenue (US$, bns)	Rank	Country/Corporation	Revenue (US$, bns)
1	United States	3251	26	Belgium	227
2	China	2426	27	BP	226
3	Germany	1515	28	Switzerland	222
4	Japan	1439	29	Norway	220
5	France	1253	30	Russia	216
6	United Kingdom	1101	31	Berkshire Hathaway	211
7	Italy	867	32	Venezuela	203
8	Brazil	631	33	Saudi Arabia	193
9	Canada	585	34	McKesson	192
10	Walmart	482	35	Austria	189
11	Spain	474	36	Samsung Electronics	177
12	Australia	426	37	Turkey	175
13	Netherlands	337	38	Glencore	170
14	State Grid	330	39	Industrial & Commercial Bank of China	167
15	China National Petroleum	299	40	Daimler	166
16	Sinopec Group	294	41	Denmark	162
17	Korea, South	291	42	UnitedHealth Group	157
18	Royal Dutch Shell	272	43	CVS Health	153
19	Mexico	260	44	EXOR Group	153
20	Sweden	251	45	General Motors	152
21	Exxon Mobil	246	46	Ford Motors	150
22	Volkswagen	237	47	China Construction Bank	148
23	Toyota Motor	237	48	AT&T	147
24	India	236	49	Total	143
25	Apple	234	50	Argentina	143

Besides consumers and businesses, policy makers can drive change towards CE. One example for a policy maker acting on the need for a systematic shift is the European Union. In 2015 the EU published their "Closing the loop – an EU action plan for the circular economy". This states that a circular economy will "save energy and help avoid the irreversible damages caused by using up resources at a rate that exceeds the Earth's capacity to renew them" (EC, 2019, 2, p. 2). The action plan presents the regulatory framework for an EU-wide transition to circular economy including guidance for circular solutions supporting production, waste management, consumption and renewable energies.

1.2 Problem

With the transition towards a circular economy more than just the systems label has to change. CE opens the doors for innovative actors, it can create new businesses and markets, create jobs and make room for creative product innovations fit for closed loop material flows (EC, 2019, 2). De Jesus *et al* (2018 p. 76) constitute that this "transition is an inherently innovation-intensive process of reconfiguration and adaptation". This requires the dedication, commitment and willingness for a systematic shift from all involved stakeholders. Policy makers can pave the way for CE implementation by enabling favourable developments. For example, developing new business models can enable CE by forming new partnerships, push new product design and changes in supply chains to achieve environmental friendliness and maintain profitability (Lieder & Rashid 2016). Ghisellini *et al.* (2016 p. 19) state that "the promotion of consumers responsibility is crucial" for establishing CE successfully. The European Commission (2019, 2, p. 6) explains further that the "choices made by millions of consumers can support or hamper the circular economy". With the increasing number and growing purchase power of the global middle class in mind the consumer and user relevance for a systematic shift towards CE cannot be overstated.

The consumers role has been defined as essential but it has not yet gained the academic and practitioners' attention that it deserves (Kirchherr *et al.* 2017). There is a necessity for further research to understand the enabling or hampering role the consumer might have. Their role within the circular system could support a larger CE implementation in society and open markets for product designers, recycling and remanufacturing businesses and support policy makers. The research on circular economy both by the scientific community and practitioners has increased in recent years where especially the industry and business perspectives have been given a lot of attention to. Kirchherr *et al.* (2017 p. 228) point out that "excluding the consumer and […] adopting a supply-side view [could lead to] developing business models that are unviable due to lacking consumer demand". Consumers and businesses might adopt or implement CE without recognizing each other's importance in the process leading to a failure of the entire concept because it is not looked at holistically (Kirchherr *et al.* 2017). Thus, there is a great need for cooperation, collaboration and inclusion of business and consumer needs throughout the shifting process and further in the new economic model.

Korhonen *et al.* (2018 p. 44) state that "inter-organizational cooperation is required between the supplier firm and the customer firm[…] and between the producer and consumer". However, industries, companies, societies and policy makers still struggle with system wide implementations as several challenges and barriers exist. Consumers and businesses have a great responsibility in enabling CE but seem to be unable to fully fulfil their expected role. Literature has identified several barriers hindering a wider implementation on both the consumer and the businesses side, but authors tend to choose either a business and industry or a consumer and user perspective. Often, the consumers play a role in the external barriers mentioned for industry and businesses why CE cannot easily be implemented (e.g. de Jesus & Mendonça, 2018). Nonetheless, there might also be an overlap or even congruence of barriers identified for both sides, the consumer or user and industry or businesses. Knowledge regarding their congruence or contradiction is still missing and Kirchherr *et al.* (2018 p. 271) point out "that careful analysis and critical discussion of CE barriers is needed to ensure that this concept will ultimately turn out to be a mainstream success".

The research gap lies in the lack of a condensed presentation of consumer and business roles and a juxtaposition of their respective barriers towards CE. A conclusive comparison of existing barriers for both actors does not exist at this point. The holistic approach of this work will contribute to closing this gap.

1.3 Aim

This thesis aims at offering a wider understanding of the intersections of important stakeholders within the system of a CE by contextualising literature from different perspectives. This study explains conditions for a transition to circular economy in terms of shared interests between businesses and consumers. The objective of the literature review is to get a contrasting juxtaposition of the barriers existing towards implementing circular economy. The following research questions serve as a structure for the analysis:

- What similarities can be found between the circular economy barriers for businesses and consumers?
- What is the nature of consumers and businesses interaction in a circular economy?
- Which conflicts of interest occur between businesses and consumer in the transition to a circular economy?

An illustrative case study that has successfully managed the intersection and interaction of businesses and consumers in this transition phase is used to see the barriers active and overcome in a practical example.

1.4 Structure of the work

The work is structured as shown in Figure 3.

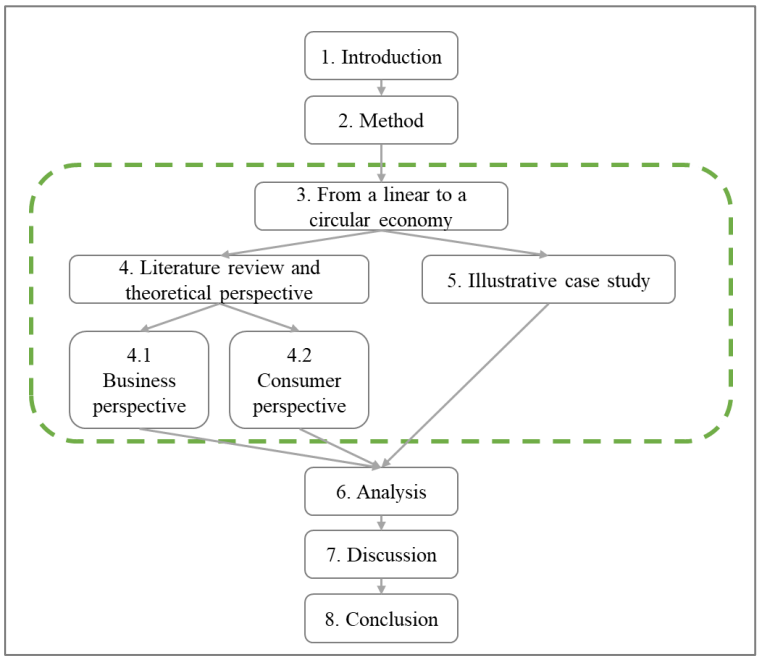

Figure 3. Structure of the work.

Chapter 1 introduces the problem, the problem background and aim of the work. It presents the research questions guiding this work and its structure.

In chapter 2 the method and methodology used are explained. The research approach and the place of this thesis within the research process as defined by Mark-Herbert (2002) is explained in section 2.1. Section 2.2 describes the process used for the literature review from planning the research and defining search criteria to analysis and result of the chosen literature. Section 2.3 presents the concept of the study and how the individual steps lead to the overall study aim. Section 2.4 introduces the theoretical framework for this thesis which is the CE model as introduced by the Ellen MacArthur Foundation (**EMF**) (2013b). Section 2.5 provides the background on the chosen illustrative case study. Ethical considerations relevant to this thesis are presented in section 2.6 followed by the limitations in section 2.7.

Chapter 3 contains an introduction into the concept of circular economy and some influencing factors regarding the shift from a linear to a circular economy. Section 3.1 informs about the systematic shift and the main differences between the linear and the circular economic model. Section 3.2 breaks down the meaning of CE. It gives an insight into the need for a common definition and the terms used mostly in the discussions around CE. Section 3.3 introduces the EU action plan that influences the decisions and developments within the EU towards CE, the pre-conditions, definitions and goals that are related to this action plan. Lastly, section 3.4 informs about the large role that waste plays in CE, the framework the EU offers for its members regarding waste management and differentiations of what waste is and how it can be treated.

The literature is reviewed and put into the theoretical context in chapter 4. Section 4.1 sheds the light on the business perspectives in a CE. It includes the business models most successful for and in a CE and the relevance of product design. This section also presents the barriers found in literature hindering successful CE implementation for businesses. Section 4.2 shows the consumer perspectives. It gives a detailed insight into the role the consumer plays or has to play and which obstacles consumers face when a CE is to be implemented.

Chapter 5 introduces the illustrative case study and expert interview chosen for this thesis. It explains the concept of ReTuna recycling mall and how it works in section 5.1and which challenges ReTuna faced or still faces while being part of a local circular concept in section 5.2.

The findings from chapter 3, 4 and 5 are analysed and put into context in chapter 6. Section 6.1 draws a direct comparison of the business and consumer barriers towards a CE pointing out the similarities. Section 6.2 relates them to the broader context of production and consumption in a CE and where and how businesses and consumers interact directly.

Chapter 7 critically discusses the circular economic concept in section 7.1, how businesses and users are enabled or hindered in CE transition in section 7.2 and the methods and approach used in this work in section 7.3.

Chapter 8 draws a conclusion of this work, its aim and provides answers to the research questions. It also gives an outlook and possible future research options.

2 Method

This chapter explains the methods used in this study as well as the structure and approach. First, it will explain the general research approach (section 2.1) and the concept of the study (section 2.2). It will in more detail explain how the literature review was conducted (section 2.3). Section 2.4 introduces the theoretical framework for this work and section 2.5 explains the illustrative case study used. Ethical considerations are to be found in section 2.6 and this works limitations are presented in section 2.7.

2.1 General research approach

The general research approach of this thesis is exploratory consisting of an illustrative case study as an exemplification for the literature-based review. Coombes (2001 p. 1) state that "research is a tool for getting you from point A to point B" and that "research is a method for investigating or collecting information". Gathering, analysing and interpreting information and using it for developing theories or testing hypothesis are important parts and results from research. It gives the opportunity to understand complex contexts and to offer possible solutions and courses of action as well as providing answers and supporting knowledge development (Wilson 2014; Hart 2018). The gained knowledge, information, analysis and understanding developed by researchers is helpful and necessary for many leaders to base their decisions on.

The core of this work is a literature-based review, thus, using an inductive, descriptive research approach (Figure 4). The research in the area of interest, circular economy, has increased within the last years due to increasing interest of scholars and practitioners (Kirchherr *et al.* 2017). However, this field of research is complex. Although many studies on the general topic of circular economy have been published over time, the research on CE indicators, drivers and barriers is still relatively limited (Ghisellini *et al.* 2016; Kirchherr *et al.* 2018). One major need in this area is a holistic approach that includes the analysis and understanding of a system on several levels (see chapter 3.1).

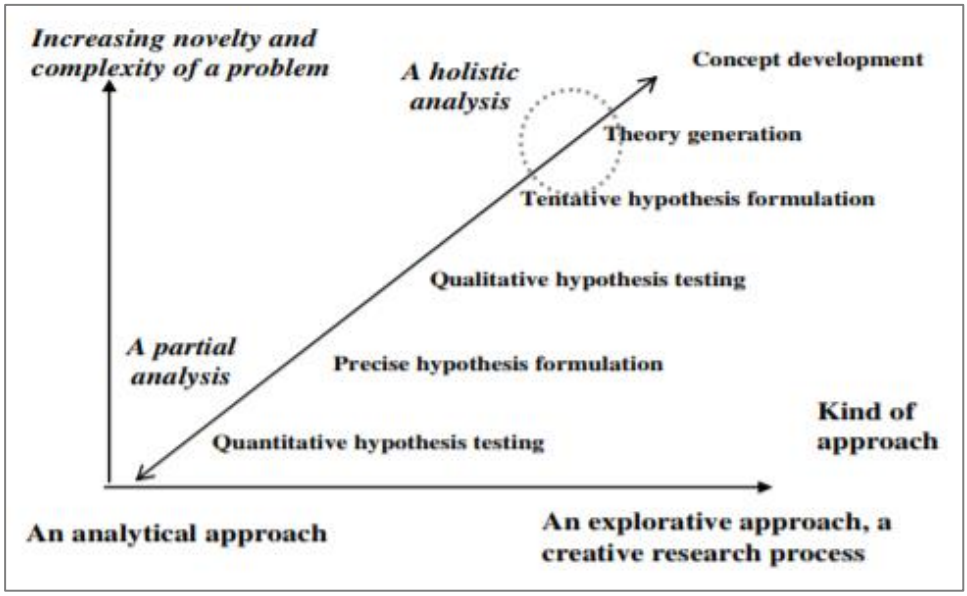

Figure 4. How increasing novelty and complexity of a problem affects the research approach and desired research contribution (Mark-Herbert 2002 p. 17).

Figure 4 depicts the place of this thesis within an overall research process. In a complex and relatively novel field of research a holistic, exploratory approach is conducted (see dotted circle in Figure 4). The exploratory approach is chosen to give a better understanding of the problem and potential mismatch of joint action of two major stakeholders within a circular economy. Exploratory research can lay the groundwork for further research and is flexible regarding the outcome. Hence, it does not aim to give a final answer but it can result in a wider range of possible options and solutions of a problem, offer further insights but leaving room for other research to be conducted (Wilson 2014; Dudovskiy 2016).

2.2 Literature review

Hart (2018 p. 5) explains that "a literature review is the analysis, critical evaluation and synthesis of existing knowledge". The purpose of a literature review is to contribute to a certain topic to enhance the understanding in this field of research for improvement in practice. It gives a picture of the current state of knowledge, thereby providing important insights into contexts and previous work and information (Blaxter 2010).

The core of this thesis is a thorough literature-based review carried out to gain a deeper understanding of the current state of research regarding the concept of circular economy, two major perspectives and the barriers for implementation of CE. As stated by Kirchherr *et al.* (2017 p. 222) "much of the work on CE (including conceptual work) is driven by non-academic players", thus, this thesis includes peer-reviewed as well as not peer-reviewed articles such as reports or policy papers. This dual approach is chosen to cover several perspectives and decrease potential biases by making this work more balanced, complete and significant. This work specifically focusses on two perspectives, businesses and consumers who are of high relevance in the CE transformation process. The approach for that is shown in Figure 5 below.

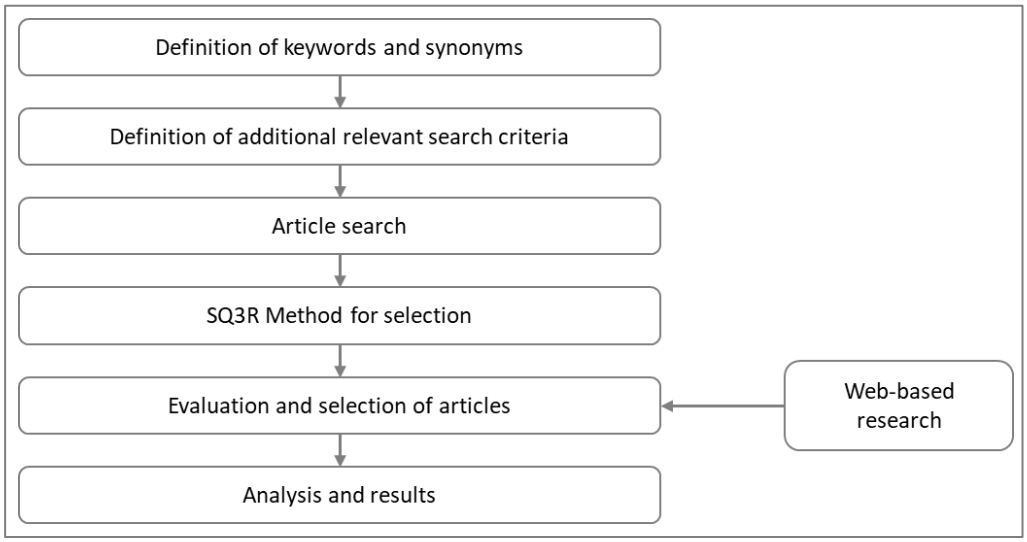

Figure 5. Literature review approach – overview.

Figure 5 gives an overview of the research approach. The different steps are explained in the sections below informing in more detail about how the literature review was conducted.

For the search criteria and review planning keywords were defined following the scope and research questions of this work. These included "circular economy" as well as possible synonyms such as "closed-loop system", "bio-economy" in combination with "barriers" and synonyms such as "limitations", "obstacles" or "hindrance". Another combination was one of

"circular economy" with regard to the perspectives i.e. the "consumer" and synonyms (e.g. "customer" or "user") and barriers relating to the consumer and industry or businesses specifically.

Conducting the review and selecting the articles was based on the search terms. Relevant studies were identified using Web of Science and Scopus and applying Boolean search techniques as well as descriptors such as "AND" and "OR". The advantage of the chosen databases is that they cover articles from all over the world to get an overview, include a vast number of peer-reviewed articles and can be combined (de Jesus & Mendonça 2018). In order to narrow down the search results the language was chosen to be English or German and the time was set to articles published from 2008 onwards. 2008 was chosen as that was the year the European Union published its Waste Framework Directive (EC, 2019, 1) which can be seen as a large step towards implementing a circular economy. The geographical focus lay on research from or about high income countries, specifically Europe, which was chosen to be the geographical boundary. As the research was also complemented using the snowballing tactic, information, especially regarding general ideas of the CE concept, may come from years prior to 2008.

To select relevant articles the SQ3R method as introduced by Ridley (2012) was applied: First, the articles were skim read and scanned for relevance by focusing on title, abstract, table of content (if available) and, if it appeared promising, introduction and conclusion. The Q introduced the questioning that followed the scan narrowing down further. The then chosen articled were read, recalled and reviewed. The number of articles and reports found for the business and industry perspective was considerably vaster than the number of articles and reports on the consumer perspective. This supports the claim made by Kirchherr *et al.* (2017) that consumers are less represented in the current CE research. 162 articles and practitioners' reports were selected for the systematic literature review and, hence, read, recalled and reviewed. Approximately 30% of the literature reviewed came from not peer-reviewed sources. The final number of sources that were chosen to be relevant for this work was narrowed down to 80.
Non-academia plays an important role in the field of circular economy conceptualisation, implementation and interpretation. Therefore, the academic research was enhanced to a general web-based research to include practitioners as well. Initiated by the previous academic literature research and the used snowballing tactic several practitioners could be identified having published relevant reports specifically regarding consumer and/or businesses involvement in the CE transition process, such as the Ellen MacArthur foundation, Accenture or EU supported CE research projects.

The results from the literature review are presented from the two perspectives that were researched: businesses and consumers. The separation allowed for a detailed research and a specific review. Some sources offered information for both perspectives and were, hence, used for both. The detailed information collected on the businesses and consumers is complemented with sources containing general information on CE.

2.3 Concept of the study

Figure 6 shows the concept used to reach the aim of this work of offering a condensed presentation and explanation of perspectives and barriers of consumers and businesses in a CE. Firstly, the literature review as explained in section 2.2 is conducted which focuses on the academic and practitioners' insight on business and consumer perspectives. The literature review gives an understanding of the overall topic, the details on the problem this work addresses and is the core of this work. An illustrative case study complements the literature

review. It provides an illustration of what is covered and found in the literature review to connect the findings with a practical example. The illustrative case study contributes to the validity of the literature findings. The illustrative case offers insights into how consumer and businesses are successfully linked, their roles fulfilled and barriers overcome in a real-world example. The expert interview complements the illustrative case study by giving in depth information on the barriers the chosen business experienced, experiences and their success strategy regarding business and consumer enablement in a CE. Thereby, the illustrative case study and the expert interview enhance the literature review and its theoretical perspective by a practical example and application.

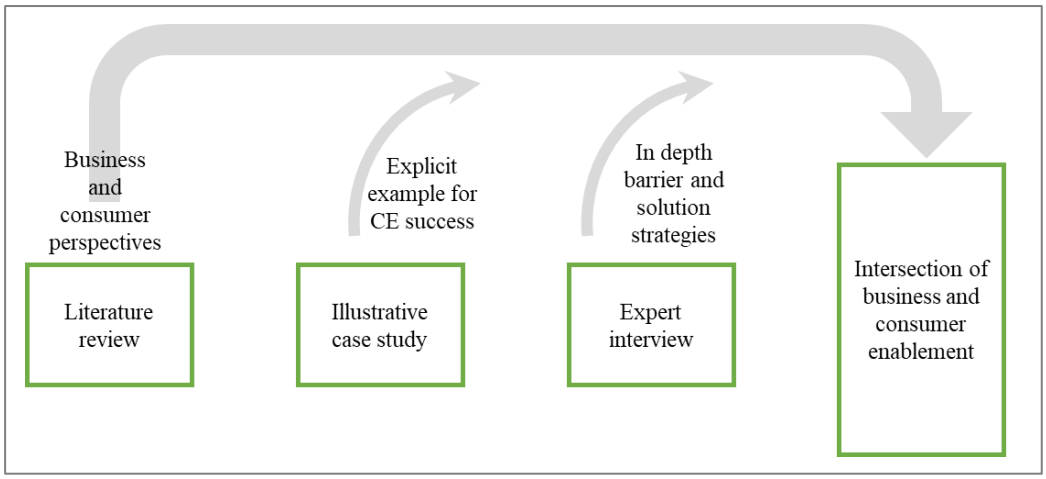

Figure 6. Research approach for the study.

The literature review, the illustrative case study and the expert interview are the key steps this work uses to accomplish the set aim and answer the guiding research questions to fill the knowledge gap identified in chapter 1.2 and 1.3. This approach is carried out within a theoretical CE framework which is explained in the following section.

2.4 2.4 Theoretical framework

The Ellen MacArthur Foundation has published a wide range of material on the topic of circular economy. According to Geissdoerfer et al. (2017 p. 759) the EMF acts as a "collaborative hub for businesses, policy makers, and academia". It was founded in 2010 to "inspire a generation to rethink, redesign and build a positive future" (EMF 2013b p. 4). Their initial report published in 2012 was seen as an impulse for research in circular economy and triggered academics as well as practitioners to engage more in this topic (Kirchherr *et al.* 2017). The CE model introduced by the EMF constitutes as the framework for this work (Figure 7).

A circular economic system aims at enabling effective material, energy, labour and information flows to optimise the entire system rather than just the components. Taking a holistic view is a key aspect for a CE. Thereby, EMF differentiates between the biological materials and the technical materials within the flows of a circular economy. Biological nutrients refer to materials designed to re-build natural capital and re-enter the biological cycles. An example for biological materials are materials that are consumed such as food and drinks. Technical materials circulate in the economy without entering the biosphere, e.g. products such as cars, furniture or packaging material, among others. In an ideal circular economy these materials are not consumed, assigning them the inevitable fade of an end-of-life status at some point, but where the materials service and function is used for as long as possible. Ideally, the life of a

product does not end with its consumption by the definition of the word as using up a resource (WebFinance, 2019, 1). For technical materials the consumer is referred to as user.

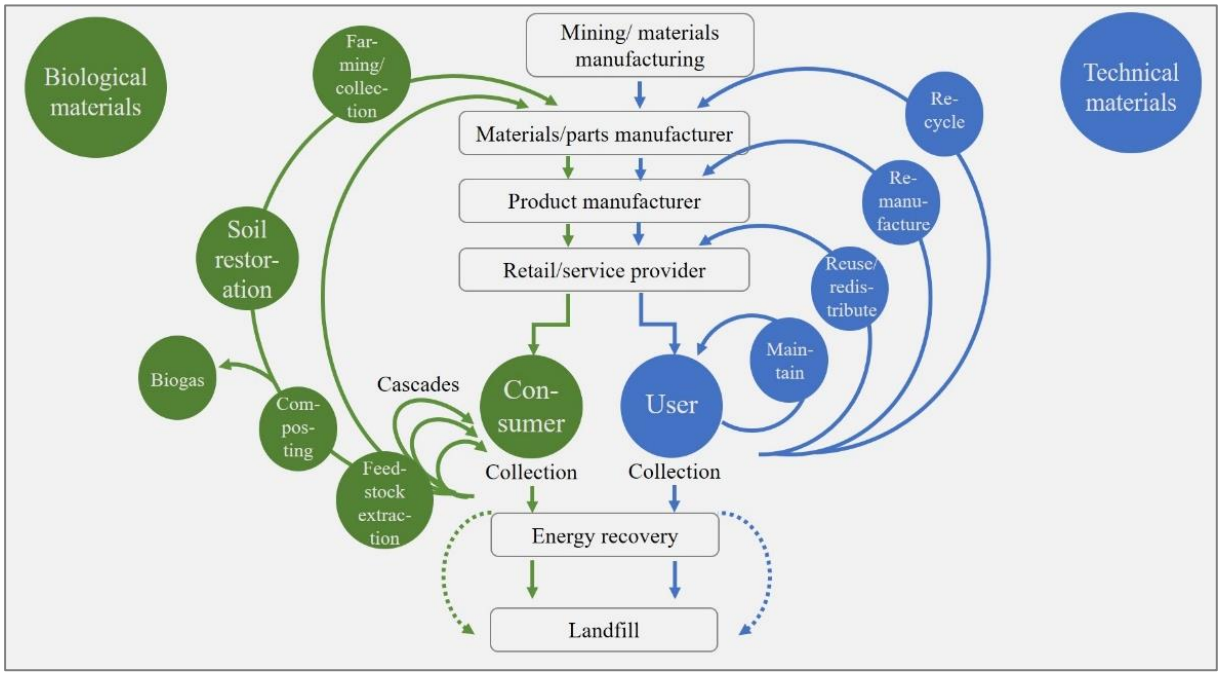

Figure 7. The circular economy model, adapted from Ellen MacArthur Foundation (2013b p. 29).

Figure 7 illustrates how the biological and technical materials circle through a circular system. As can be seen on the left side of the figure, the biological materials cascade to other applications meaning that, for example, their stored energy is extracted as happens with food being consumed for energy. This work, however, focuses on the right side of the figure – the technical materials. EMF explains this side as "the functionality, integrity and the value of embedded energy are maintained through remarketing, reuse, disassembly, refurbishment and remanufacture" (EMF 2013b p. 29). Figure 8 shows a simplification of the EMF Model for a better understanding.

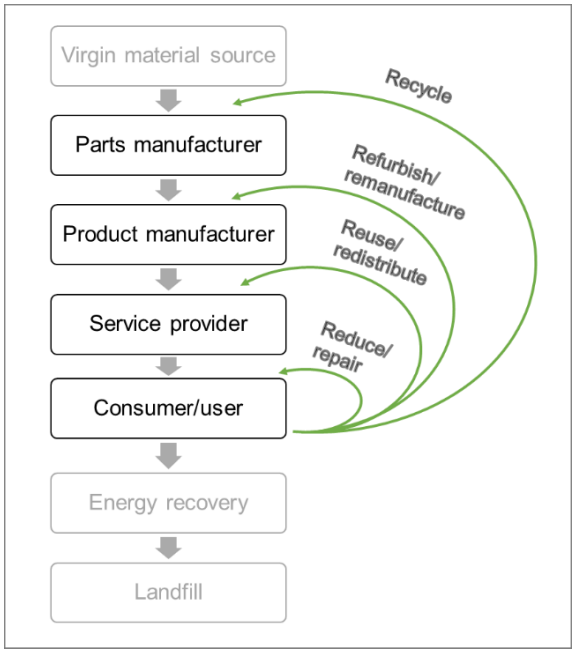

Figure 8. Simplified circular economy model, adapted from Ellen MacArthur Foundation (2013b).

The models idea of a closed loop product lifecycle can be seen clearly in Figure 8. The loop can be closed along the different stages of the product lifecycle which are based on the 4R principle of repair/reduce, reuse, refurbish and recycle. Thereby it can be said that the smaller the loop, the higher the material and energy efficiency (EMF 2013b): repairing a product such as a bike has a lower need for raw materials and energy than a redistribution with potentially long transportation or than refurbishment where old parts could be entirely replaced by new parts from raw materials.

According to the EMF (2013b p. 26ff.) CE is based on several natural principles:

- *Design out waste*: In a cycle made for prevention, repairing, reusing, remanufacturing and ultimately recycling of materials, waste does not exist
- *Build resilience through diversity*: Modularity, redundancy and adaptivity need to be prioritized in a flexible and diverse system to be resilient in case of shocks and stress
- *Shift to renewable resources*: A restorative CE needs less energy enabling the system to run on renewable energies as, additionally, integrated food and farming systems need less fossil-fuel based inputs but could capture energy values from by-products
- *Think in systems*: A holistic perspective understanding influences and relationships is crucial to build resilient and efficient flows in the complex system
- *Think in cascades*: Cascading biological and technical materials through other applications offers the opportunity to create extra value for products and materials

The principle of system thinking takes a dominant role in the shift towards circular economy. A paradigm shift introduced by the understanding of connected, feedback driven systems is needed for creating and developing the circular economy (EMF 2013b). A rebalancing needs to take place leading to system thinking and understanding of complexity. For example, it is necessary to move away from pure analysis towards a synthesis. Individual learning and benefit, for companies as well as civil individuals, needs to become a team, group or cluster learning and effort (EMF 2013b p. 79).

2.5 Illustrative case study and expert interview

Until today there are few businesses that successfully participate in a circular concept in one way or the other. Amongst them are businesses that offer second-hand clothes, businesses that offer to repair their products when broken, businesses that offer modular customisable products for easy replacement or repair or businesses that offer their product as a service (further explained in chapter 4). This work focusses on a unique example of directly connecting with the consumer to install a local circular business. ReTuna, a recycling mall in Sweden, successfully manages its consumer intersection in a circular manner (more details on the ReTuna are given in chapter 5).

The semi-structured expert interview was conducted with Ms Anna Bergström who has been the manager of ReTuna recycling mall since the beginning and was involved in the initial planning as well. A guideline for questions was developed before the interview. The questions aim at getting insights into the barriers experienced along the development of the business from the very early planning to today's profitable business model. The interview took place at the managers workplace at ReTuna, lasted approximately 30 minutes and was recorded and later transcribed (see Appendix 1). Bergström was chosen as an expert as she has knowledge, both in theory and practice, of circular economy. She has experience in opening and starting a business active in a circular environment and leading it to success. In addition, a talk by Bergström given to a visitors group and the author of this work was recorded and transcribed (see Appendix 2), which was also consented to. The talk included general information about

ReTuna and lasted approximately 15 minutes. The answers are analysed and used as given by the manager and no coding is necessary.

The illustrative case study was chosen to enrich the literature review with a practical example. It connects the theoretical findings with the real world and deepens the results found in literature. It can give further insights into practical CE implementation as a niche business to this point but which can lead the way for changes on a larger scale. This specific ReTuna case is chosen to verify the findings of the thesis regarding business-consumer intersection on a case that has implemented and used it successfully. The few businesses offering a circular concept limited the choice for the exemplary case to an accessible and local illustration.

2.6 Ethical considerations

The research on circular economy is based on several assumptions about the consumer and customer behaviour and the role of businesses in it. Murray et al. (2017 p. 269) argue that "while the Circular Economy places emphasis on the redesign of processes and cycling of materials, which may contribute to more sustainable business models, it also encapsulates tensions and limitations". These tensions and limitations are especially visible when upscaling the concept of CE. The author is aware of potential bias and subjectivity and aimed at balancing that by checking for cross references and multiple citations in various sources, specifically so for the web-based search to ensure the quality.

This work focuses on the concept of a circular economy. From a principle point of view ethical aspects are visible in different perspectives in the literature review. A careful selection of literature includes making choices of positive as well as negative views on circular economy. This where the ReTuna case illustration is valuable. It provides insights on the practical perceived limitations. Ethical aspects are also visible in the research conduct as reflected choices concerning data collection (GDPR and informed consent). It was made sure that the interviewee at ReTuna had given an informed consent to recording, transcribing, using and publishing the information provided during the interview.

2.7 Limitations

There are some possible delimitations for this work. Much of the information is gained from secondary sources. Those are sources from literature of practitioners and academia but it is limited to 80 sources of which some are published by the same authors. As the literature review is the core of this work, the perspective if predominantly theoretical. Only one practical example was used for the illustrative case study, thus, no generalisations can be made without further research.

This work uses the CE model as introduced by the EMF but other models, interpretations and definitions exist. Further, the unit of analysis is the business and consumer perspective. However, other CE stakeholders might be important as well. The focus additionally lies on the business-to-consumer relationship as opposed to a business-to-business relationship although a business could be a consumer, or user, too. That aspect is only of minor interest in this work. This subjectivity could lead to a method error.

The analysis focuses on economies in high income countries and is placed in the European context of guiding policies and supply chains. Literature used for specifics on business and consumer barriers was chosen with that background. Within the European boundaries the focus lies upon the micro level (explained in section 3.3) reducing complexity to a specific setting and focussing on the interaction of only two stakeholders in a CE.

3 From a linear to a circular economy

Chapter 3 provides an introduction into the concept, definition and framework of circular economy. It gives insights into the transition from a linear to a circular economy and the necessity for this shift (section 3.1). It also presents different definitions for CE as found in literature and defines CE for this work (section 3.2). It shows the European context of CE (section 3.3) as well as highlighting the role of waste and waste management (section 3.4).

3.1 Circular Economy framework

The linear make-use-dispose model has dominated the economic system in the high income countries since the industrial revolution (Lieder & Rashid 2016). Figure 9 shows the main concept of a linear system: A products lifecycle starts with the necessary resource extraction followed by production and product distribution. The product is then consumed i.e. the resource is used up. In most of the cases the product ends up as waste on landfill or incineration plants with a consequent release to the environment in form of emissions or even as solid waste. In the beginning of the industrial revolution the idea of mass production with low production costs and high product availability favoured this system. It could quickly supply growing populations, increased production and economic power. Lieder and Rashid (2016 p. 37) comment that "after the industrial revolution disposable products with the explicit purpose of being discarded after use [stimulated] throwaway-mindset which is today known as linear consumption behaviour". This mindset is, thus, routed in consumption behaviour since the late 18th century.

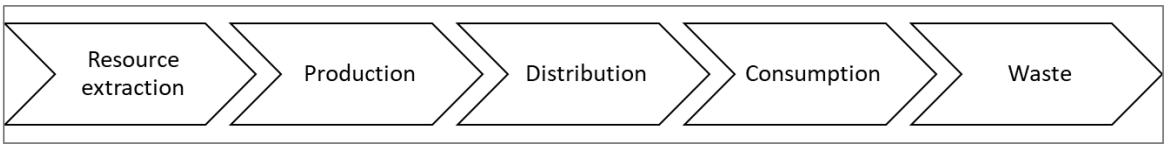

Figure 9. A linear economical model, adapted from Unterfrauner et al. (2017 p. 8).

According to Heshmati (2017 p. 13) the produced waste cannot disappear as "the amount of resources used in production and consumption […] cannot be destroyed and are equal to the waste that ends up in the environmental system". This has several consequences. The resource extraction becomes more efficient. With scarce and limited resources companies, industries and individuals aim at finding new extraction possibilities while keeping their costs low and their supply constant (Van Buren *et al.* 2016).

In order to supply a growing world population production keeps increasing simultaneously. With the resources being limited the demand of exponential economic and population growth becomes ever more difficult to be met (Lieder & Rashid 2016). In addition to the increasing pressure on the last limited resources for production, the Ellen MacArthur Foundation (2013b p. 15) states that "we are sitting on a consumption time bomb". Within the next 20 years it is expected that three billion additional consumers will enter the market. One main reason is the growing middle classes in emerging markets especially in the Asia-Pacific region (EMF 2013b). With this increase comes an increase in waste generation. One explanation is the increased material intensity as the new group of consumers entering the markets chose manufactured and packaged goods instead of unbranded products. The impact of packaged goods is much higher "both because of processing losses and packaging" (EMF 2013b p. 15). Another exemplary reason for an increase in waste is the production for the mass market resulting in quantity over quality for the product and its sourcing and consequently a relatively short product lifespan (Cooper 2013). The throwaway mentality is closely linked to the linear

economic model (Gullstrand Edbring *et al.* 2016). Therefore, while pressure increases on resource extraction, the amount of waste keeps increasing. The amount of waste already produced is often left unused at landfill sites while it keeps growing (Lieder & Rashid 2016).

The linear model is responsible for the current wealth in many of the high income countries as relatively low resource prices in relation to the labour costs "have been the engine of economic growth" (EMF 2013b p. 17). However, this wealth has also created a "wasteful system of resource use" (EMF 2013b p. 17) and brings with it several threats. The growth in production, consumption and waste generation stresses the global environment. Providing resources, act as a life support system and being a sink for waste and emissions are economic functions the environment serves. Nonetheless, there is usually no price on the stress caused for the environment by linear produced or consumed products. Prices do not reflect the negative impact caused (Ghisellini *et al.* 2016).

According to Cooper (2013 p. 137) "the global predicament that this [economic growth] poses is that people in affluent countries are unwilling to give up, while in newly industrialized and other poorer countries people are unwilling to do without". In other words, while several countries want to increase their consumption to follow the goal of economic growth, the high-income countries would need, but are unwilling, to reduce their consumption. Global resource scarcity does not allow the current levels of consumption for everyone around the globe. Gullstrand Edbring *et al.* (2016 p. 1) bring it to the point: "Western consumption patterns are unsustainable: if the world's 7 billion inhabitants had consumed in the same way as the Swedish population does today, we would need 3.25 Earths to support this lifestyle". The negative impacts caused by the make-use-dispose linear economic model, therefore, threaten "the stability of the economies and the integrity of natural ecosystems that are essential for humanity's survival" (Ghisellini *et al.* 2016 p. 11). Humanity's survival is on threat as "measured by the land area that can support human habitation, the earth is shrinking" (Korhonen *et al.* 2018 p. 38). Korhonen *et al.* (2018 p. 38) summarize the negative impacts by stating that "deserts are expanding, the sea level is rising, the population is growing, per capita consumption is increasing, the volume of livestock and cattle is growing and biodiversity is depleting at ever faster rates". The rapid environmental degradation caused by the wasteful make-use-dispose system has led to a change in thinking among practitioners and academics, politicians, businesses and civilians to implement a system of sustainable development, production, consumption and policies (Heshmati 2017).

One logical way to change the linear system is its reverse: closing the waste loop to form a cyclical flow of materials and energy rather than the linear chain (Korhonen *et al.* 2018). A circular economy considers the value of a product to stay within the economic system even after it presumably has become a waste product. Waste emissions and generation is minimised along with an efficient energy, material and water consumption (Geng *et al.* 2013). By closing the loop and including the concept of CE in an economic system resource use can become more efficient, especially regarding urban and industrial waste, aiming at a better balance between the economic system, the environment and the society (Ghisellini *et al.* 2016).

3.2 Definition of Cirular Economy

The concept of circular economy is a trending topic amongst academics and practitioners (Kirchherr *et al.* 2017) but it is not new. According to Hesmathi (2015) it was mentioned already in the 1960's with a more scientific and academic development of the model in the 1990's. CE has not appeared out of nowhere as a possible solution for sustainable development and as an alternative economic system. It has developed from different fields of scientific definitions and frameworks that have emerged around ideas for sustainability. Among these are concepts such as industrial ecology, industrial ecosystems, industrial symbiosis, cleaner production, product-service systems, eco-efficiency, cradle-to-cradle design, biomimicry, performance economy or the concept of zero emissions, to just name a few (Korhonen *et al.* 2018). All the different themes that have an influence on the understanding of CE make a common definition ever so much more important as CE "means many different things to different people" (Kirchherr *et al.* 2017 p. 221). On the one hand there are "various possibilities for defining CE" (Lieder & Rashid 2016 p. 37) but on the other hand there "is no commonly accepted definition of CE" (Yuan *et al.* 2006 p. 5). Missing a common definition could eventually even lead to a collapse of the entire concept as a mistrust in the binding ability can occur (Blomsma & Brennan 2017).

Table 2 shows a selection of different CE definitions that are used in academia and among practitioners. The definitions shown in Table 2 have several similarities such as CE being a concept for waste reduction (Geissdoerfer *et al.* 2017; Kirchherr *et al.* 2017; Scott 2017; Camacho-Otero *et al.* 2018; Korhonen *et al.* 2018). In addition, the idea of materials reuse, maintenance and general resource use reduction is common amongst the presented definitions (EC, 2019, 2; Kirchherr *et al.* 2017; Scott 2017; Korhonen *et al.* 2018). Nonetheless, the definitions also show differences in the level of detail and focus. Heshmati (2017) does not mention waste as part of CE at all. According to Kirchherr *et al.* (2017) the waste hierarchy itself (further explained in section 3.4) is rarely mentioned as part of a CE definition and especially rare amongst practitioners. As can also be seen by the definitions of Table 2 social equity and the consumers role in CE are only rarely mentioned by scholars or academics (Kirchherr *et al.* 2017).

For this work the definition as set by the Ellen MacArthur Foundation is used which reads: "[CE] is an industrial system that is restorative or regenerative by intention and design […] it replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models" (EMF 2013a). This definition accounts for the need of material and product circulation, waste reduction and a closed loop system.

Table 2. Circular Economy definitions

Source	Suggested CE definition
Camacho-Otero *et al.* (2018 p. 1)	"A circular economy aims at decoupling value creation from waste generation and resource use by radically transforming production and consumption systems"
Ellen MacArthur Foundation (2013a p. 7)	"[CE] is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models"
European Commission (2019, 2, p. 2)	"[A] circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy"
Geissdoerfer *et al.* (2017 p. 759)	"A regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling"
Heshmati (2017 p. 251)	"Circular economy […] is a sustainable development strategy proposed to tackle urgent problems of environmental degradation and resource scarcity"
Kirchherr *et al.* (2017 p. 224)	"A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level […], meso level […] and macro level […], with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations"
Korhonen *et al.* (2018 p. 39)	"Circular economy is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society-nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources and cascading1-type energy flows"
Scott (2017 p. 6)	"A concept used to describe a zero-waste industrial economy that profits from two types of material inputs: (1) biological materials are those that can be reintroduced back into the biosphere in a restorative manner without harm or waste (i.e.: they breakdown naturally); and, (2) technical materials, which can be continuously re-used without harm or waste"

One important aspect of CE is the circularity and closing the loops in the economic system but other objectives are related to a CE implementation as well: Economic growth and social and technological progress should not be hindered (Lieder & Rashid 2016). This is further supported by Ghisellini *et al.* (2016 p. 12) stating that CE needs a "balanced and simultaneous consideration of the economic, environmental, technological and social aspects of an investigated economy, sector, or individual industrial process as well as of the interaction among all these aspects". Kirchherr *et al.* (2017) define the three goals of a circular economy to be environmental quality, economic prosperity and social equity. The latter does not take a technological aspect into account but is otherwise in agreement with the former mentioned authors. Economic prosperity is a prominent aim amongst practitioners ranking environmental quality only second indicating that CE is seen as an opportunity for growth and less for sustainable development (Kirchherr *et al.* 2017).

In order for the goals to be fulfilled, a circular economy needs to be implemented on different levels to induce a necessary systematic shift from the current to a new system (Sakr *et al.* 2011; Linder *et al.* 2017). Figure 10 shows the three different implementation levels.

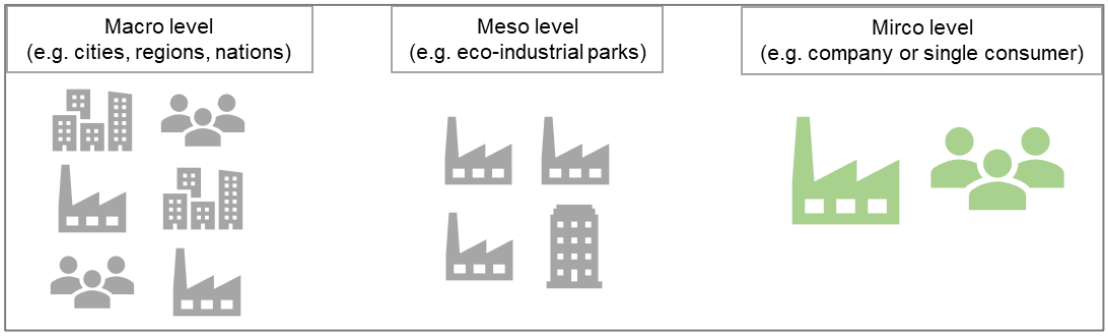

Figure 10. Implementation levels of the circular economy, adapted from Ghisellini et al. (2016 p. 12).

One way to classify the different levels is the vertical approach: The macro level of analysis includes cities, regions and even nations in its examination, the meso level focusses on conglomerates of businesses forming relationships or a symbiosis as they might, for example, do in an industrial park, and the micro level analysis takes place on the single or few company or single consumer or small consumer group level (Sakr *et al.* 2011; Ghisellini *et al.* 2016). This work focuses on the micro level of analysis (see also chapter 2.7)

3.3 The EU action plan for Circular Economy

The idea of implementing a circular economy has recently also found its way onto political platforms. CE partly got attention with the EU waste directive (EC, 2019, 1) which puts the waste hierarchy and waste management into focus (see section 3.4 for further details). In 2015 an EU action plan for the circular economy followed which contained in more detail the different focus areas and their relevant tasks towards a transition to a more circular economy. The EU action plan calls out the economic benefits as their main goal. A CE "will boost the EU's competitiveness" (EC, 2019, 2, p. 2) by protecting against price volatility resulting from the fight for scarce resources. It will also create jobs by making room for new businesses and innovative ways for production and consumption. The environmental perspective is mentioned as CE will "save energy and help avoid the irreversible damages caused by using up resources at a rate that exceeds the Earth's capacity to renew them in terms of climate and biodiversity, air, soil and water pollution" (EC, 2019, 2, p. 2). According to the action plan, transitioning towards CE goes hand in hand with EU priorities such as "jobs and growth, the investment

agenda, climate and energy, the social agenda and industrial innovation, and with global efforts on sustainable development" (EC, 2019, 2, p. 2). Businesses and consumers are seen as key enablers for driving the transition process. In order to support the process for actors from local to national levels the EU action plan identified several steps along the supply chain. They also emphasize the action needed on all parts of the supply chain from production to consumption.

Regarding the production the design phase as well as the production process itself are seen as relevant. Product design can largely influence a products durability, repairability or remanufacturing. This can support recyclers to "disassemble products in order to recover valuable materials and components" (EC, 2019, 2, p. 3) which are key for CE. The report points out that currently the interests of producers, consumers and recyclers differ largely making the necessary market change difficult. Production processes have the risk of using resources inefficiently and generating large amounts of waste. As raw materials will still be needed, even in a circular economy, the European Commission promotes the "sustainable sourcing of raw material globally […] through policy dialogues, partnerships and its trade and development policy" (EC, 2019, 2, p. 5). Because Industries play an important role in production processes and in the transition for CE the European Commission underlines the need for industrial symbiosis which can allow waste and by-products to become useful for one another.

With regard to consumption as part of the supply chain the EU action plan accentuates that consumers can "support or hamper" the circular economy (EC, 2019, 2, p. 6). Among the factors influencing consumers choice in the context of CE favoured consumption the action plan names eco-labels, price and product design for repairability and reusability. The European Commission wants to introduce an understandable, user friendly labelling system that includes product information on environmental performance, durability and energy performance. Furthermore, member states of the EU are encouraged to offer price incentives and use economic instruments for prices to better include and present actual environmental costs. This could influence the consumer purchasing decisions and encourage the purchase of CE products (EC, 2019, 2). In addition, the need for system requirements regarding availability for spare parts for product repair, infrastructure for re-use and remanufacturing as well as the need for "innovative forms of consumption […] e.g. sharing products or infrastructure" (EC, 2019, 2, p. 7) are mentioned as supportive for the development of a circular economy. Improvements within the waste collection and recycling process are necessary, especially regarding collection and sorting. Although the support for the transition towards CE from the EU is underlined, "making the circular economy a reality will […] require long-term involvement at all levels, from Member States, regions and cities, to businesses and citizens" (EC, 2019, 2, p. 3)

3.4 Closing the waste loops in a Circular Economy

An elementary part of CE is the handling and management of waste and waste flows (Ghisellini *et al.* 2016). Practitioners and academia have used the so called R- frameworks in the context of waste management but also as part of the concept for CE for several decades now (Kirchherr *et al.* 2017). The R's refer to the several principles related to waste management. For example, the **3R**'s stand for reduce, reuse and recycle. The 3R principle as key concept for CE has developed as research intensified and implementation and application of CE increased.

For the successful implementation and application of measures for any kind of waste prevention, reduction and recovery, a common understanding of the different terms and their using opportunities is important. One possibility to address this is the European's Commission Waste Framework Directive (EC, 2019, 1), henceforth short as **WFD**. Besides recommending different ways for waste treatment it recommends a waste hierarchy (Figure 11) which is also

used for defining CE in an academic context (Kirchherr *et al.* 2017). The hierarchy gives a priority order to how waste should be treated: from the most preferred option of waste prevention to the least favourable option which is waste disposal (Gharfalkar *et al.* 2015).

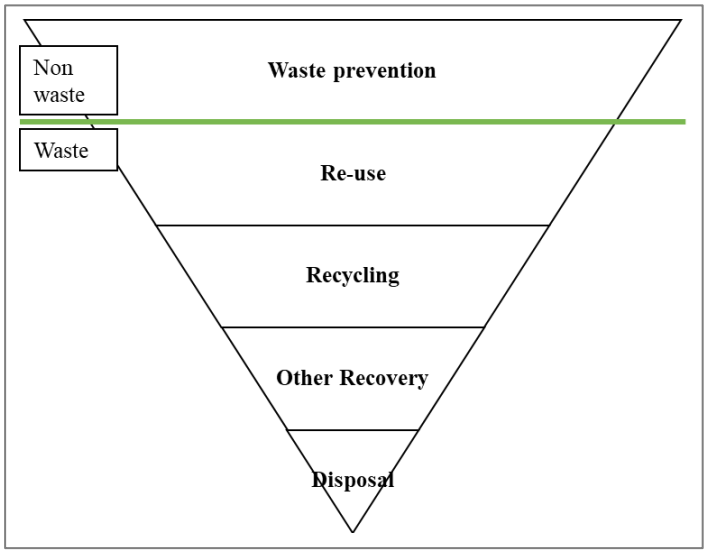

Figure 11. The EU waste hierarchy, adapted from Gharfalkar et al. (2015 p. 306).

In addition to the mentioned 3R's, 'recover' is introduced making it a **4R** principle. The EU waste hierarchy differentiates between treatment for 'non-waste' and 'waste'. The WFD (2008 p. 9) defines waste as "any substance or object which the holder discards or intends or is required to discard". The terms of the WFD waste hierarchy (2008 p. 10) are defined as follows:

- *Prevention*: ''Measures taken before a substance, material or product has become waste that 'reduce' the'': (1) ''Quantity of waste, including through the re-use of products or the extension of the life span of products'', (2) ''Adverse impacts of the generated waste on the environment and human health''; or (3) ''Content of harmful substances in materials and products''
- *Preparing for reuse*: "Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing"
- *Recycling*: "Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations"
- *Recovery*: "Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy".
- *Disposal*: "Any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy

The WFD (2008) classifies material reuse not as an independent measure but as part of waste prevention and, therefore, reuse is supposedly used for non-waste products only. The WFD (2008 p. 10) defines it as "any operation by which products or components that are not waste are used again for the same purpose for which they were conceived". Gharfalkar *et al.* (2015) conclude that the logical place for reuse should be after 'preparing for reuse'. They argue that reuse could include several other options such as repair, refurbish, recondition or remanufacture

(Gharfalkar *et al.* 2015). Reusing materials and products is now a key concept: reuse requires fewer resources, needs less energy and labour and reduces pollution (Castellani *et al.* 2015).

In a circular economy, material and product reuse "represents a relevant new niche of business" (Castellani *et al.* 2015 p. 374). Second hand shops, charity shops, vintage shops and re-sale manufacturing sites can profit from an increased reusing of products (Castellani *et al.* 2015). However, this idea of product treatment has some obstacles to overcome. Firstly, Prendeville *et al*. (2014) highlight that there needs to be a demand by the consumers for reused or remanufactured products in order for it to work (for more detail see chapter 4). With a potentially increased consumer demand producer willingness to engage in the process needs to be given. The manufacturer needs to be willing and able to recirculate their product. An important enabler is a durable product design which can go through several consumption circles. Acting as an economic tool on the producers side is the Extended Producers Responsibility (**EPR**) which can be seen as a modern version of the polluter pay principle (Ghisellini *et al.* 2016). EPR aims at transferring the costs for disposal or recovery to the producer. Thereby, the producer becomes more active in reusing, recycling or disposing of their waste materials to reduce these costs (Ghisellini *et al.* 2016). Furthermore, the authors argue that "if a product cannot be reused, recycled or composted, then the industry should not produce such a product and consumers should not buy it (Ghisellini *et al.* 2016 p. 16). It highlights the importance of a shared consumer and producer responsibility.

Recycling of waste is another waste treatment option offering the opportunity to regain still usable resources from materials classified as waste. The overall quantity of waste is reduced as is the amount of raw materials needed for production and the impact on the environment decreases. Gharfalkar *et al.* (2015) suggest to differentiate between types of recycling: Up-cycling means reprocessing materials to a product of higher value, e.g. making a bag out of waste sailcloth. Re-cycling can be understood as reprocessing waste into a material of the same purpose or value, e.g. reprocessing a used plastic bottle into a plastic bottle again as it happens in the concept of a deposit system. Down-cycling as the last term refers to waste that is reprocessed to a material of lower use or value, e.g. after several recycling circles paper fibres become too short to be further recycled but a newspaper might still be used as animal cage lining. Walter Stahel, professor and founder of the Geneva-based Product-Life Institute, who advocates circular economy since the 1980's, concludes that "recycling is the least profitable and sustainable strategy of the circular economy" (EC, 2019, 3).

As several materials, such as Rare Earth metals, can rarely be recovered within economic profitability their recycling rate is low. Other metals and plastics might be recyclable to a certain extend or also unrecyclable if they contain contaminants and toxics (McDonough & Braungart 2010). The resource efficiency and profitability in terms of material recycling is, therefore, naturally limited by material complexity and abuse (Stahel 2013). Regarding CE, recycling is a very relevant component as Kirchherr *et al.* (2017) conclude that it is the most common waste related term in academic CE definitions. However, even a circular economy cannot guarantee a 100% recycling rate. No economic system can ever be fully circular returning material, products and energy back to raw materials endlessly due to the 2nd thermodynamic law (Ghisellini *et al.* 2016). Another drawback of recycling as a prominent concept of CE is, that "if everything can be recycled there is no need to reuse/ reduce" (Ghisellini *et al.* 2016 p. 16). This and the high level of downcycling leads to the need for a reconsideration of the entire supply chain process before implementing recycling processes or following a waste hierarchy (Kirchherr *et al.* 2017).

The EU WFD mentions 'other recovery', such as energy recovery, and 'disposal' which are the least favourable waste treatment options as they are linear rather than circular. Van Eijk and Stegemann (2016) criticize that the waste hierarchy leads to a reduction of waste ending up on landfill sites but is incapable of sufficiently protecting the environment and reducing the consumption of natural resources. In addition, Kirchherr *et al.* (2017 p. 226) found that the 4R's as introduced by the WFD are rarely mentioned by practitioners who have "little interest in promoting reduction since this may imply curbing consumption and economic growth".

Several authors suggest solutions for the shortcomings of the EU waste hierarchy especially with regard of adopting a circular economy. Ghiselini *et al.* (2016) expand the 3R principle of reduction, reuse and recycling by three principles developed by the Ellen MacArthur Foundation: 'Appropriate design' aims at avoiding waste by designing products for "a cycle of disassembly and reuse" (EMF 2013a p. 8). The principle of material 'Reclassification' separates waste into reusable waste, the technical materials, and into waste that goes back to the biosphere for cascading use, the biological materials (see also chapter 2.4). 'Renewability' as a third principle declares renewable energy as the main energy supplier for a circular economy.

Another suggestion to improve the waste hierarchy is the extension of the 4R principle as introduced by the EU to a **9R** framework (Table 3).

Table 3. The 9R's framework, adapted from Kirchherr et al. (2017 p. 224)

Increasing circularity

R	Strategy	Description
0	Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
1	Rethink	Make product use more intensive (e.g. sharing product)
2	Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
3	Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
4	Repair	Repair and maintenance of defective product so it can be used with its original function
5	Refurbish	Restore an old product and bring it up to date
6	Remanufacture	Use parts of discarded product in a new product with the same function
7	Repurpose	Use discarded product or its parts in a new product with a different function
8	Recycle	Process materials to obtain the same or lower quality
9	Recover	Incineration of material with energy recovery

Table 3 offers an even more detailed hierarchy for waste treatment than the EU waste pyramid. From the top (0-Refuse) to the bottom (9-Recover) it ranks the waste handling opportunities there are for businesses as well as consumers and mainly everybody using or consuming any kind of product. The first two R's (0 and 1) demand a general change in consumption behaviour. The consumer is expected to decide consciously even before consuming what to buy, where to buy or to reduce the amount bought. This behaviour is not yet common in the linear system. R3 to R7 refer to reusing a product in one way or the other.

4 Literature review and theoretical perspective

This chapter presents the findings from the literature review and the theoretical perspective on the roles of businesses and consumers in a circular economy. Section 4.1 firstly presents the perspective of businesses including circular business models and the role of design. Secondly, it presents the barriers identified for businesses for moving towards a circular economy. Section 4.2 introduces the central role of the consumer in a CE and delineates the barriers consumers encounter when acting in or moving towards a circular economy.

4.1 Business perspectives

The three most frequently defined aims of a circular economy are environmental quality, economic prosperity and social equity of which economic prosperity is the most prominent especially among practitioners (Kirchherr *et al.* 2017). Monetary and economic aspects are predictably the main focus of practitioners with business and company success and profit making in mind. However, the pressure put on the environment and nature presses on industry, companies and businesses, as well. Resource scarcity, natural catastrophes, cyber-attacks, interstate conflicts and an increasing world population causing an increased demand bring along unknown challenges, risks, uncertainties and possibly instabilities to economic systems (Weetman 2016). Businesses have to face their vulnerabilities and possible supply risks caused by the several challenges if they want to remain in the market and they have to deal with the increasing competition for resources (Lieder & Rashid 2016). One way to do so is by exploring and using new, less accessible, more costly locations for sourcing the raw materials causing further damages (Van Buren *et al.* 2016). This further increases the pressure on societies and environments and does not solve the issue of limited resources. Another way is changing the ways of production.

4.1.1 Role of businesses, business models and design in a Circular Economy

In the currently dominant linear economic model, at the end of its life a product is disposed of with all its valuables and resources it contains. Ellen MacArthur, the founder of the Ellen MacArthur Foundation, states that "businesses can benefit by creating circular material flows - generating value again and again [and] the circular economy provides the opportunity to improve resilience and competitiveness, regain control of resources and ultimately drive growth" (Dame Ellen MacArthur in Kingfisher PLC, 2013). Ellen MacArthur points out that adapting a circular economic system or becoming part of one offers several advantages for businesses. One advantage is that it makes businesses, regions or even countries less dependent on material imports because materials can be reused and value is kept in the multiple product lifecycles as long as possible (Van Buren *et al.* 2016). The European Commission (2019, 2, p.2) emphasises that a circular economy can "boost the EU's competitiveness by protecting businesses against scarcity of resources and volatile prices, helping to create new business opportunities and innovative, more efficient ways of producing and consuming [and] it will create local jobs". New market and employment opportunities offer chances for businesses in addition to reducing their environmental impact.

Within the business perspective business models are highly relevant for a circular system transformation and to enable businesses in a CE. Osterwalder and Pigneur (2010 p. 14) define business models as describing the "rationale of how an organization creates, delivers and captures value". Establishing a sustainable business model is one opportunity to adapt sustainable solutions such as a circular supply chain. In a circular supply chain, the different organisational units of a company cooperate, communicate and configure across their business

units and organisational functions in order to close energy or waste loops, reduce resource consumption and leakages and work together towards sustainable competitive advantages (Geissdoerfer *et al.* 2018a). On a general note circular business models as such can be seen as the core of a circular economy (e.g. Lewandowski, 2016). This work will briefly talk about the relevance and chances associated with developing a sustainable or circular business model for a better understanding.

Literature offers a wide variety of ways to define sustainable business models (e.g. Stubbs & Cocklin, 2008; Witjes & Lozano, 2016; Moratis *et al.*, 2018). Geissdoerfer *et al.* (2018b p. 409) define a sustainable business model as "a business model that incorporates pro-active multi-stakeholder management, the creation of monetary and non-monetary value for a broad range of stakeholders, and which holds a long-term perspective". Including non-monetary values and a long-term perspective are a key differentiation for sustainable businesses. It enables companies to create sustainable competitive advantage and build resilience to the several strategic challenges (EMF 2013a). In the transition towards CE companies can actively drive the shift by designing their business model in a sustainable or circular way. Figure 12 illustrates the possible shifts companies can make.

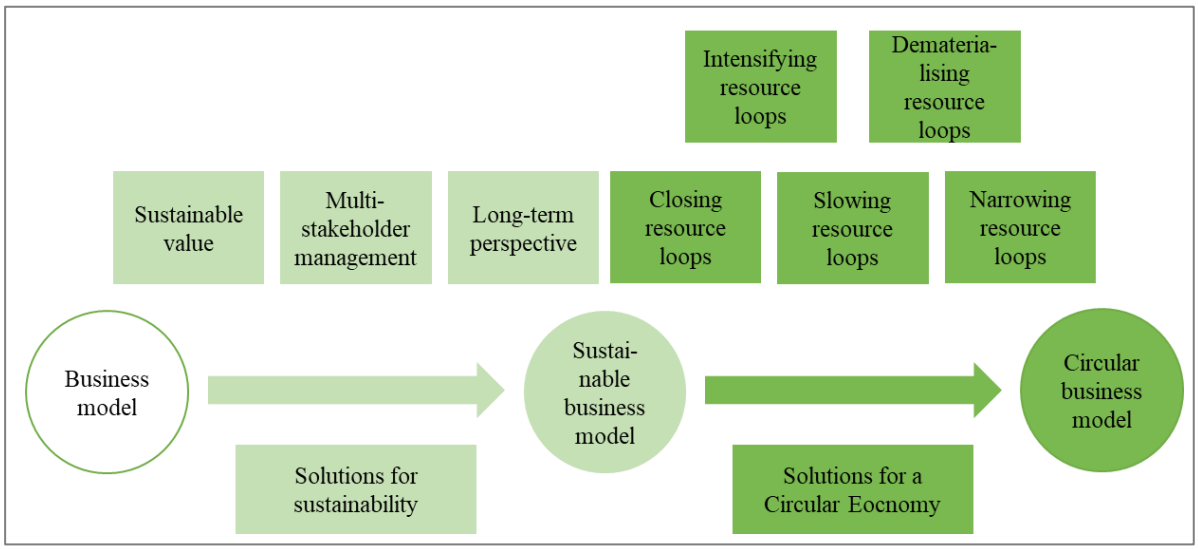

Figure 12. Traditional, sustainable and circular business models in comparison, adapted from Geissdoerfer et al. (2018a p. 717).

In order to develop a sustainable business model a company can begin to include the aspects of sustainable values, pro-active stakeholder engagement and a long-term perspective as pointed out in the definition of sustainable business models. The next step is moving towards a circular business model that "describes the rationale of how an organization creates, delivers and captures ecological, social and economic value that is restorative and regenerative by intent" (Pheifer 2017 p. 8). It adds the important closing, slowing down or narrowing of the several loops such as waste, energy and resources (Geissdoerfer *et al.* 2018a). This is only one presentation of how a business might chose to move into a circular direction. Business models must, however, be considered in the CE discussion and in a successful transition. Kirchherr *et al.* (2018 p. 228) formulate it as "a CE understanding lacking business models is one with no driver at the steering wheel".

Accenture, a global management consulting and technology services company, actively drives the transition to a circular economy. They conduct researches and cooperate with leading

organisations such as the World Economic Forum to push a CE transformation (Accenture, 2019, 1). Accenture (2019, 1) has identified five business models that are supportive of a successful transition because they fully, or in parts, contribute to the CE concept:

1. *Circular Supplies*: Instead of using pollutive raw materials this business model focusses on using renewable energy, bio- or fully degradable resources for consecutive lifecycles.
2. *Resource Recovery*: This business model forms a production and consumption system that can recycle, reuse and recover resources and energy. It also asks for a fully working return chain that can recapture end-of-life products and put waste created to use for other purposes.
3. *Product Life Extension*: Companies become enabled to extend their assets and product lifecycles and maintain values longer. Products are designed for repairability, durability, upgradability or recyclability. This model also needs a reverse logistics system in place to reuse, disassembly or recycle a product after it is no longer functional or economically useful.
4. *Sharing platform*: With this business model cooperation and collaboration amongst product users are promoted for sharing overcapacity or underutilisation to maximise product utilisation.
5. *Product as a service*: This business model offers an alternative to "buy and own" as products are used by one or even more customers by a leasing or pay-per-use principle. The value of a product is not measured by volume but by performance instead.

The above demonstrate the different possibilities a business has to contribute to a CE shift. Furthermore, it shows the need for the different stakeholders to interact to form circularity. It makes clear that product design as well as considering the customer, especially in model 4 and 5, are vital. In a CE the customer is not only a consumer and user but a valuable and relevant resource for circularity and cooperation (Camacho-Otero *et al.* 2018). Lewandowski (2016) shows more than 25 different business models that work well in a circular economic environment and customer relations and customer segments are an important part of it. New business models based on services rather than natural resources by decoupling economic growth is a major advantage of a circular economy. The interaction of the different components in the system such as product design, infrastructure and return systems, business strategy and users is necessary. The services provided should outweigh economic growth in the decoupling (Govindan & Hasanagic 2018). When looking at Figure 8 (p.11), the simplified circular economy model, the importance and relevance of businesses of all kinds in the holistic view of a circular economic system becomes apparent: They are parts manufacturers, product manufacturers and service providers interacting with the user either at the beginning of a products life-cycle through the selling process or in a later stage when the product or parts come back to be redistributed, refurbished or recycled.

Businesses are the primary driver for a shift to a circular economy (EMF 2013a). As such businesses have several possibilities to become more circular and close their material loops. These influential leverage points along the supply chain are shown in Figure 13.

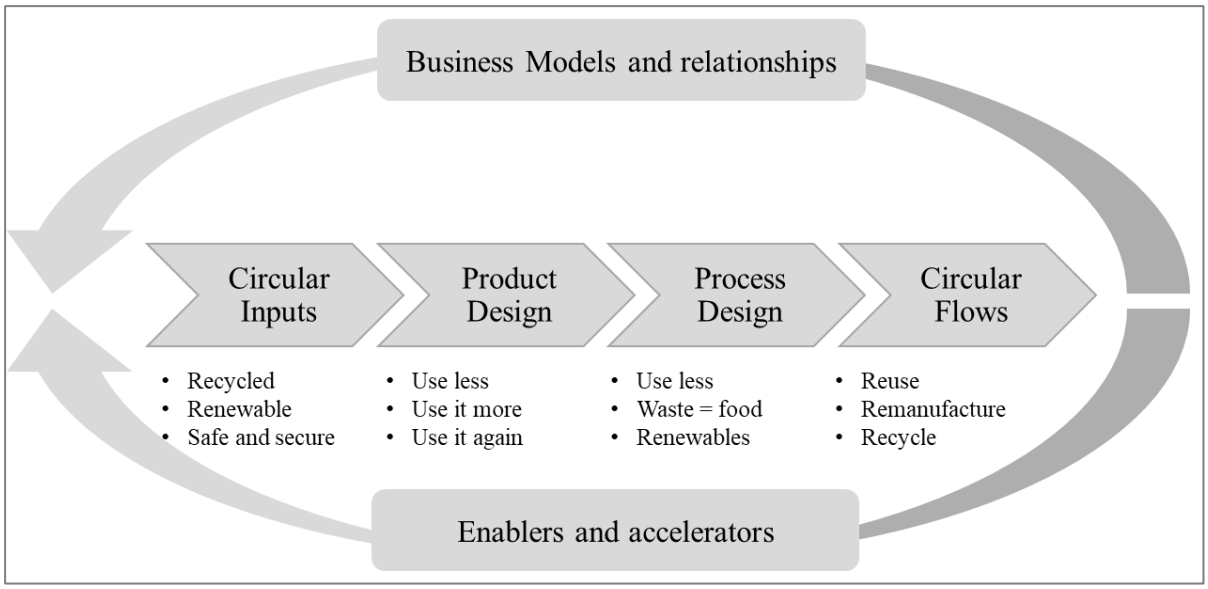

Figure 13. The four blocks of the central flow in a circular economy framework, adapted from Weetman (2016 p. 26).

A business can use the four blocks of circular inputs, product design, process design and circular flows to improve and rethink their products and processes for a circular model. They do not have to be changed all at once or at the same time but rather can be starting points for a change. What has been identified as key in a successful transition to CE is the field of design (Wastling *et al.* 2018). Although the concept of design in this context goes beyond product design, product design is, nonetheless, a very important and relevant factor and one of the four blocks of the central flow in a supply chain (Figure 13). Wastling *et al.* (2018 p. 3) present five major topics in circular product design: "future proof design, design for disassembly, design for maintenance and design for remake and recycling". This also relates to one of the main principles of CE as stated by the Ellen MacArthur Foundation, which is to design out waste. By using less input material, especially virgin material, and producing with recycled materials instead, contributes to a more sustainable production. Designing a product to become more durable, future proof and made for repair, reuse or recycling is part of the "use it more" idea as developed by Weetman (2016). Design for assembly indicates a good product design in a closed loop economy. This can support material recovery and reduce energy demand for material production. Modular design concepts, pay-per-use or collaborative initiatives are just a few examples for circular design measurements (Weetman 2016). Furthermore, the earlier the product design is adapted to work well in circular solutions the better. The further down the value chain the more components are added and the harder it becomes to make major changes and adaptations (Bocken *et al.* 2016). Circular inputs are of great need for a circular product design. Using recovered or recycled materials, possibly with renewable materials and avoiding hazardous or toxic materials and emissions can make a difference in the environmental footprint of a business and contribute positively to a CE.

Another design aspect is process design. With a good process design, circularity can be achieved throughout the entire supply chain. Resource efficiency can be achieved by making full use of not fully utilized inputs or waste arising during production. "Waste=food" as part of process design refers more to the biological materials as defined by the Ellen MacArthur Foundation. Especially in the food-producing or processing industry waste arising from the process, e.g. orange peel as waste form orange juice production, can be used for another product such as extracting oils from the peel for cosmetics before sending it for energy use (Weetman

2016). A system approach is important for the process design. Using renewable materials in the product design along the process affects procurement decisions as well.

The final block in the supply chain of a circular operating company are circular flows. Circular flows are very closely related to the waste management in a circular economy explained in chapter 3.4. Ideally and in a holistic approach the product design determines the waste management. A product designed for repair or reuse might be used in several cycles before it is disposed of by the user. However, the business has the chance to include and reuse its own product, or parts, again in their production process if they have a well-handled reverse logistics system in place. The repatriation of the used product for recycling or remanufacturing can become part of the recycled material inputs in the production process. This can include upcycling where the company designs a new product from the previous one, a basic repair measure to keep the product in use longer or downcycling by using at least parts of it again (Weetman 2016).

4.1.2 Barriers for businesses for moving to Circular Economy

Businesses play a key role in the shift to a circular economy and several aspects such as sustainable or circular business models and supply chain design can enable them. However, companies also face constraints in their "innovation-intensive process of reconfiguration and adaptation" (de Jesus & Mendonça 2018 p. 76). Barriers can be present at different levels, micro, meso and macro level, can be internal or external and can occur throughout the entire supply circle. In literature a lot of research on the issue of business or industry barriers for moving towards a circular economy exists. A structured and detailed representation is offered by Govindan and Hasanagic (2018) who group the different barriers: Governmental, economical, technological, knowledge and skill, management, Circular Economy framework issues, culture and social and market issues. The CE framework issues will, in this work, be referred to as infrastructural issues because infrastructure is included by other authors specifically as well (e.g. Preston 2012; Houston *et al.* 2018).

Governmental issues for one refer to the lack of standardisation for the CE system performance with relation to process standardisation or consumption reduction indicators (Su *et al.* 2013). This means that making CE implementation and success measurable and comparable can help identify improvement potentials in the change process more easily and, thus, accelerate the implementation in general. Consumption reduction indicators set by an official body such as a government could support businesses to see their immediate success. Indicators and standardisation also support officials to monitor CE implementation at the different levels more easily (Su *et al.* 2013). According to Houston *et al.* (2018 p. 23) practitioners miss performance indicators and see the "lack of information and clarity on the availability and eligibility of EU funds to support circularity". Further, the governmental barrier includes the insufficient implementation of laws and ineffective recycling policies to ensure high quality recycling in the CE environment (Govindan & Hasanagic 2018). The waste management and treatment process is not yet fully included in a circular way in current policies. The European Waste Framework Directive is a starting point for handling waste as a potential resource. However, waste incineration also in European countries still prevents material recovery (Ghisellini *et al.* 2016). Taxes also act as a barrier toward CE implementation. According to Ghisellini *et al.* (2016 p. 23) "taxing renewable resources as labour" instead of imposing higher taxes on less environmentally friendly products or the use of non-renewable resources is a hindering factor. Regulation or legislation hindering reusing by-products and waste or regaining ownership from customers for a waste product need to be removed (Ghisellini *et al.* 2016; Govindan &

Hasanagic 2018). Rizos *et al.* (2015) additionally identified a lack of support from local authorities hindering companies to implement CE.

Economic barriers seem to impose the largest obstacle for businesses for moving towards a circular economy and circular business model. According to literature findings, several surveys concluded that enterprises doubt the profitability of the CE system, see a barrier in major up-front investment costs while at the same time the price for reused, remanufactured or recycled products is difficult to establish (Govindan & Hasanagic 2018; Houston *et al.* 2018). In addition, Bicket *et al*. (2014 p. V) identify a "lack of sufficient incentives due to […] insufficient internalisation of external costs" and "limited economic incentives for […] repair and reuse". Businesses do not see additional value in repairing or reusing instead of offering brand-new products. The authors also point out that "current levels of resource pricing […] do not encourage efficient resource use, pollution mitigation or innovation" (Bicket *et al.* 2014 p. V). The costs for using resources to their limits are relatively low and the economic necessity to change is rarely given. This together with higher prices for environmentally friendly sourced or produced products, the increased production costs within a CE are seen critically by many companies (Govindan & Hasanagic 2018). In the current growth oriented economy high margins, profits and low production costs are the main goals (Muniz & Cruz 2015).

Technological barriers refer to issues related to material tracking and quality assurance (Govindan & Hasanagic 2018). As Figure 8 (p. 11) shows parts manufacturers, product manufacturers and service providers in a CE are expected to take back products and materials from the user. It requires the companies to, firstly, ensure a certain product quality throughout the entire lifecycle. Secondly, there is a need for good quality of products from recovered materials with potential material fatigue as well. Thirdly, the already mentioned product design challenges are a technological barrier as separating the materials for reuse, remanufacturing or recycling as well as creating durable products from recovered materials can be difficult (Govindan & Hasanagic 2018). Manufacturers often miss the needed technical equipment to fulfil the requirements of letting reused products enter their production processes again.

Knowledge and skill barriers relate to a general lack of awareness and a lack of the "sense of urgency by the public" (Govindan & Hasanagic 2018 p. 20) with an additional misconception of the quality of reused or refurbished products (Govindan & Hasanagic 2018). It also includes the information deficit for public and enterprises regarding a large scale circular economy (Bicket *et al.* 2014). The how, when or who is not clear. It is unknown who is supposed to act and under which preconditions. Business can easily continue 'as usual'. The lack of a commonly accepted and understandable definition of CE is also part of this barrier. The definitions found in literature might not even be known to business leaders acting outside the academic world. Furthermore, a gap in skills of the employees supposed to work in or with a circular economy hinders a successful CE implementation regarding internal waste separation opportunities, sustainable packaging or design issues, to name some examples (Rizos *et al.* 2015). The perception of waste as dirty and negative can reduce enthusiasm to work with it.

Management barriers such as organisational structures build around a linear economy can make CE implementation within and outside a company difficult. A poor leadership that does not support CE or other strategic priorities such as growth or market expansion are a barrier towards CE implementation (Govindan & Hasanagic 2018). The paradigm shift from purely growth focused to sustainable growth and production needs open minds and management abilities beyond the current perspectives. Changing the business model, or parts of it, need a certain understanding, knowledge and drive to be implemented. Producers need to play a more active

part in moving away from the "passive throwaway culture" (Ghisellini *et al.* 2016 p. 27). Preston (2012) also points out that a failure in company cooperation in a globally connected supply network makes the needed working together in a CE difficult. The development of eco-industrial parks is an example of cooperation within an industry: cooperation makes it possible for the waste of one company to become the resource of another e.g. the wastewater produced by one company becomes the cooling water for the next company (Preston 2012). For such a concept to work beyond one industrial park or one industry not only communication and willingness to cooperate is needed but also the infrastructure. Management is required to act together and offer transparency to make their waste stream accessible to others for use.

Infrastructural barriers refer to the delivering services in a circular economy and barriers with or along the supply chain. Delivering services can include "transportation and communication systems, water-recycling systems, clean energy and electrical power lines" (Ghisellini *et al.* 2016 p. 22). The proximity of production and consumption of any kind of energy or material, or a lack thereof, can aggravate making the waste of a company the resource of another or of the consumer. An example for this are biogas plants. Heat is a waste product of the energy production from crops and manure in a biogas plant. The heat could be used for supplying residents from the district heating system (Preston 2012). Current energy supply systems often rely, however, on long-distance heating. The existing infrastructure hinders a local use of waste heat although it could minimize transportation and insulation costs and waste heat emission into the environment (Preston 2012). In a CE, products might come back to the producer along the entire production process as new, recovered material, as products to be remanufactured or to be repaired, or as a product that needs to be taken apart and recycled. Businesses either need to collect their circular resources or they need to be brought to them. However, even in a local context the recycling processes can be complex and the needed logistics and infrastructure is not fully developed (Salim *et al.* 2019). The complex international supply chains complicate CE implementation as they make a reverse logistics system, waste management and inclusion of all sub-suppliers even more complex (Govindan & Hasanagic 2018).

Culture and social barriers for businesses relate to a lack of enthusiasm towards CE and a, perceived, lack of consumer demand for such a system. Communication and cooperative management are necessary for a CE. Still, Salim *et al.* (2019 p. 33) identified a "lack of coordination among producers and recyclers". This is supported by practitioners who mention the "lack of knowledge of industries on what other industries /companies offer as resources, recycled materials, discarded materials [and] lack of trust and openness to share and collaborate" (Houston *et al.* 2018). Implementing a circular system needs more than one party to cooperate and become involved. Without trust and openness it is doomed to fail. This relates also to the management issues and shows the deep roots of the linear economy. It is rare to include discussions on other companies' waste production and how it can be useful for the own business. The perceived lack of consumer demand refers to the lack of understanding and knowledge of CE in general and the higher prices for circular products limit consumer demand (Houston *et al.* 2018). The details behind this lack are further discussed in the next section 4.2.

Market issues refer to the platform barriers imposed by the current market structures. According to Houston *et al.* (2018) practitioners miss a market for secondary (raw) materials that would support refurbished, reused or repaired products. Market barriers are also linked to the cultural and infrastructural issues in which taking products, materials or waste back from other companies is not common yet (Govindan & Hasanagic 2018). Market issues also include the consumers desire for ownership which will be further looked at in chapter 4.2.

4.2 Consumers perspectives

In any economic model the consumer plays a vital role. The consumer creates demand, consumes and handles products through their lifetime. The growing global middle class leads to increased consumption, creating even more demand (Lieder & Rashid 2016).

4.2.1 Role of consumers in a Circular Economy

Within a circular economy the role of the consumer, or rather user, becomes even more important. The Ellen MacArthur circular economy model (Figure 7, p. 11) places the consumer and user in the centre of all material and product flows. As can be seen in Figure 8 (p. 11), the user in a CE has the power to decide the fate of a product: the user can decide to repair a product, hand it over for reuse or refurbishment or, ultimately, recycling. Kirchherr *et al.* (2017 p. 228) call the user the "most central enabler" of CE.

A change from a 'throwaway mentality' towards sustainable consumption behaviour to make CE successful is required (Korhonen *et al.* 2018). In recent years, alternative consumption models have experienced a renaissance or were developed further aiming for a more sustainable consumption pattern. Among the alternative consumption models are collaborative consumption, second-hand consumption and access-based consumption models (Gullstrand Edbring *et al.* 2016). In short, collaborative consumption refers to a reduction in resource consumption through sharing or exchanging products rather than buying them. Examples are car sharing, repair cafés or tool sharing (Gullstrand Edbring *et al.* 2016). Second-hand consumption gives the user the chance to buy a used product rather than a new one. Thereby, the impact on virgin resources and waste production can easily be reduced. Instead of buying a new product the user extends the life of an already used product (Gullstrand Edbring *et al.* 2016). Access-based consumption refers to the shift from selling the product ownership to the user to selling the function or service of a product. Typical examples are renting or leasing options such as renting a car from a car rental company rather than buying one.

Besides alternative consumption models the meaning of consumption in general changes in a circular economy. The consumer becomes a user which will change the attitude towards the products, the meaning, nature and dynamic of consumption. Consumption will have five distinct characteristics in a CE: anonymity, connected consumption, multiplicity of values, political consumerism and uncertainty. Camacho-Otero *et al.* (2018 p. 14 f) explain them as follows:

- *Anonymity*: As products are used rather than owned the user might not identify with the product much anymore and the relation towards the product becomes more anonymous.
- *Connected consumption*: Networks, consumer-business-interactions and sharing become key principles.
- *Multiplicity of values*: Circular solutions need to be functional, create symbolic values and include the users' well-being, too. This is also true for a linear economy but frugality becomes an additional value in CE that defines consumption.
- *Political consumerism*: In contrast to the previous material consumption, the dematerialised consumption will be the standard in CE.
- *Uncertainty*: An uncertainty comes with the loss of ownership and potential loss of immediate availability when products move between users and between producers and users more frequently.

According to Camacho-Otero *et al.* (2018) the user in a CE plays an interactive role and needs to be included in the production process already as early as in the product design phase. As

product design for repairability, reusability or at least recyclability is important on the producers' site for a closed loop supply chain, the user has needs as well. A product should be designed also to fit the daily routine of the user easily (Camacho-Otero *et al.* 2018). In addition, emotions should be considered and integrated. The product design should enable the user to form a relationship with the product e.g. through customisation, to create a positive attitude and interaction (Stacey & Tether 2015). Wastling *et al.* (2018 p. 3) suggest that to "incorporate more human-centred thinking into the design of circular products and services, [encourages] designers to appreciate how the user fits within the system". The design of products and the way a CE system is implemented can drive the user to accept the need for a behavioural change more easily (Wastling *et al.* 2018).

Camacho-Otero et al. (2018 p. 12) have identified seven factors that influence the attitude of consumers towards circular solutions: "personal characteristics, product and service offering, knowledge and understanding, experience and social aspects, risk and uncertainty, benefits, other psychological factors" (Figure 14).

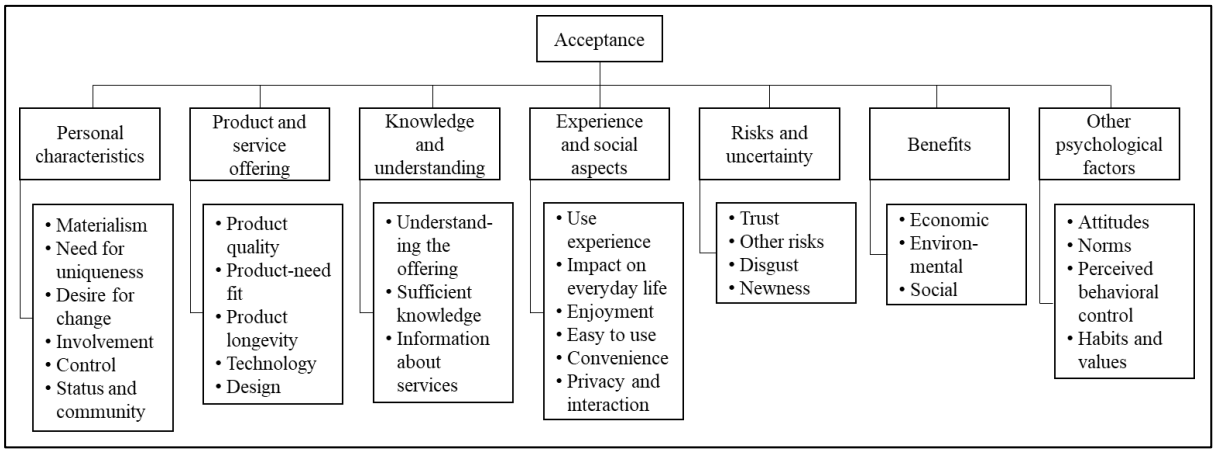

Figure 14. Factors influencing users attitudes towards circular solutions, adapted from Camacho-Otero et al. (2018 p. 12).

The acceptance of CE is influenced by personal characteristics. Depending on the extent the person values material possessions, desires change and uniqueness or has a sense of status the acceptance for CE can be higher or lower. Valuing them highly leads to a constant demand for new or more products hindering a circular flow of consumption (Camacho-Otero *et al.* 2018). Acceptance is influenced also by the overall product and service offering. The better the product quality and the better the product fits the persons need, i.e. the better the product design, the more likely the person is to perceive CE positively (Camacho-Otero *et al.* 2018). Knowledge and understanding can increase acceptance if the offering of circular products and solutions is fully understood and appreciated. Being informed about the services offered in a CE and which choices exist for a user in a sustainable environment support a positive attitude (Camacho-Otero *et al.* 2018). In return, a lack of knowledge can "lead to erroneous perceptions regarding the quality of remanufactured products or the hygiene of sharing schemes" (Camacho-Otero *et al.* 2018 p. 13) which is further discussed in the next subsection 4.2.2. Experience and social factors are influential on users CE participation because they influence the personal feeling a user develops towards the system: If the solution can be easily included in the everyday life, if it brings enjoyment , is easy and convenient to use the user has a positive relation with the product (Camacho-Otero *et al.* 2018). A positive experience with the solution in the past can lead to a positive attitude towards similar solutions. Once the first prejudices or fears are overcome or the evidence to the contrary was given the future acceptance can increase (C.A.R.M.E.N., 2019,

1). The aspect of risks and uncertainty include the potential trust issues occurring with refurbished or reused products as well as missing trust of consumers towards other users of shared products (Camacho-Otero *et al.* 2018). They influence the users' willingness to actively participate or even accept a circular solution of any kind. Benefits can be of economical nature regarding potential cost savings but also environmental benefits can positively impact consumers' attitudes towards CE. Social benefits can be found in the social-hedonic perception of engaging in sharing with others (Lutz *et al.* 2018). The factor of other psychological factors includes habits, attitudes, norms or intentions. They influence the individual acceptance of circular solutions and even if they hinder or prevent the use of circular solutions the habits are unlikely to be (Camacho-Otero *et al.* 2018). A positive attitude and spirit of acceptance for such solutions can, thus, be influenced and hindered by psychological factors that are difficult to influence. They act on a very individual level and can vary widely among different age groups or societal groups making them hard to measure. Even if a user has a positive attitude towards CE and the acceptance factors shown in Figure 14 influence the behaviour positively regarding CE several obstacles might still hinder CE implementation. several obstacles. These are further explained in the next subsection.

4.2.2 Barriers for consumers for moving to Circular Economy

User become the centre of attention and action in a CE. However, their active participation and involvement is needed to fulfil that new role. The barriers preventing this are diverse and multifarious in literature. In order to structure the literature findings, the barriers for consumers were grouped similarly to the business barriers mentioned in section 4.1: Product use, knowledge, infrastructure, economic and attitude related.

Product use related barriers refer to the issues occurring before, during or after the consumption of a remanufactured or reused product in a CE. According to Gullstrand Edbring *et al.* (2016) a main issue with consuming second-hand products is a concern for hygiene and pests. Their survey discovered that the fear of bringing home pests in second-hand furniture or developing health issues when wearing second-hand clothes is an issue. The same obstacle was found for access-based consumption and collaborative consumption models where consumers fear to receive an unclean product from previous users (Gullstrand Edbring *et al.* 2016). Baxter *et al.* (2017 p. 508) define this as contaminated interaction which "is concerned with impurities in an objects value due to past use". This contamination can be real or imagined but it can negatively affect the consumers decision making. The perceived contaminated interaction is influenced by factors such as familiarity with the previous owner: the more familiar the previous user or owner is the lower the feeling of disgust becomes (Nemeroff 1995). In a circular economy, contaminated interaction can negatively affect circularity. A product might be downcycled instead of re- or upcycled because of hygienic concerns with it. It is not a downcycling in value as explained in chapter three section four but rather the imagined devaluation given to the product. In addition, when at the end of life of a product the owner decides to dispose of it "contaminated interaction has the potential to lead to sorting errors" (Baxter *et al.* 2017 p. 510). The user knows how the product was treated during its lifetime or which, maybe perceived, defects it might have and might decide that it is not worth a second lifecycle. Someone unaware of this might well use the product again because it is of lower importance and less personally affected. Changing the users' perception of circular products can be difficult. One way could be to reassure a new potential user of the safety of use or the hygienic process the product went through before reselling. Abbey *et al.* (2015 p. 9) conclude that "reminders of the remanufacturing and sterilization process can have unintended consequences and make consumers even more averse to purchasing the remanufactured product". Instead of feeling reassured the new user might become aware of all the potential risks unthought of before.

Related to potential sorting errors and another product use related barrier is product design. A design for repair, reuse or recycle, can encourage correct sorting or rather product attachment and caring for it (Wastling *et al.* 2018). Designing with the users' needs in mind regarding the disposal process can lead to a higher participation in circular solutions (Wagner 2013). A difficult sorting or material separation can, related to CE acceptance of product use convenience and simplicity to use (Figure14, p.31), hinder a positive product experience. The user might choose to dispose of the product in the easiest but maybe not best way, e.g. household waste rather than a proper waste separation, due to less user-oriented product design.

Knowledge related barriers include lacking consumer awareness and inadequate education regarding the CE concept. The information available to the user and the possible interaction with CE is limited if not insufficient (de Jesus & Mendonça 2018). The theoretical CE concept is not yet commonly known, practical examples are limited and public attention is rather low. The Ellen MacArthur Foundation states that the current education system "mirrors that of our economy", referring to the linear system, and that "education requirements must evolve to enable learners to grasp 'whole systems' design" (2013a p. 78). By educating about sustainability and CE concepts as early in the education process as possible the system change can be driven from an early stage in the young users' consumption process. Learning about such a concept can change the perception of and behaviour in a CE concept (Andrews 2015). Understanding is an important step to accepting a new idea and knowing the reason behind the change can lead to active participation. The lack of knowledge and awareness that waste can and needs to be seen as a resource hinders the full unfolding of a CE (Lieder & Rashid 2016). Waste in the linear system is the end of product life when a product has served its purpose. Finding a new purpose through recycling or material recovering is a CE challenge. Not knowing how to recycle, not knowing which materials can be recovered or why to make the sorting effort has a negative effect on user participation and involvement (Wagner 2013). The users cannot fulfill their new, central role in CE.

Infrastructural barriers occur during the interactive processes where the user wants to participate but is potentially hindered by several factors. One factor is the convenience of waste disposal. Especially regarding the increased focus on waste recovery and waste as a resource the responsibility for the user at the end of a products life increases. Whether a product is true waste to fully be disposed of or can be reused is a decision the consumer has to make. Beyond perceiving the product as less valuable which leads to sorting errors, a complicated or long recycling or disposal process will not make the user participate. Wagner (2013 p. 499) states that "the more inconvenient each step [of the process] is, the lower the likely participation rate and thus the lower the recovery rate". Although recycling is the least favourable option for an object, if it occurs, it should be done correctly (Wastling *et al.* 2018). Wagner (2013) identified convenience in the recycling process, recycling opportunity and proximity to the collection side in distance as well as in time as important elements for successful CE participation. The proximity to the recycling site in terms of distance and time can be a hindering factor for the users' convenience when recycling a product. The larger the distances or the longer the time to get to the site the less likely the participation. Other convenience factors include drop-off procedures and possible fees at the recycling side. Opportunity to recycle relates to opening hours, the complexity of the process such as vehicle access, sorting and storage requirements as well as the physical effort involved (Wagner 2013). It also depends on whether the user is situated in a well-connected city environment or on the countryside with potentially longer distances. An infrastructure that includes high efforts for the user when wanting to recycle acts as a barrier towards CE. Going to recycling sites and waste separation and sorting competes with the convenient 'throwaway mentality' to simply use the household waste which involves the least effort. Wagner (2013 p. 502) concludes that "the more services offered at a drop-off

site, the farther a householder is willing to travel to recycle". This indicates that convenience offered at the site and a low effort involved once the distance has been overcome can lower the infrastructural barrier to use a recycling site. Part of the infrastructural barrier is also the availability and opportunity to use circular solutions, purchase circular products and use collaborative consumption models. A place to purchase products that were produced in a sustainable, maybe even circular, way is difficult to find in modern societies even if the user is willing to accept a longer distance to reach it (Isenhour 2010).

Economic barriers relate to the consumers' willingness to pay and prices and price expectations for reused, recycled or refurbished goods. As in almost all purchasing decisions the price is highly relevant in the decision-making process. Prices for circular products can be higher than for conventional ones due to different sourcing, producing and distribution processes (Govindan & Hasanagic 2018). Users might not see or know about these processes but see the higher prices. If the function and use experience are otherwise similar the higher price might impose a barrier for the CE solution. The willingness to pay for a rented product in collaborative consumption depends, among others, on the uncertainty of it being available when and where needed or the quality offered. Depending also on the individual attitude, renting or sharing a product can be seen as a cost factor rather than a cost saving factor. Especially in the long-term renting is currently more expensive than purchasing to own (Gullstrand Edbring *et al.* 2016). The price is a large determining factor for whether a user chooses a circular product. In the case of reused products that might even carry a 'like new' guarantee the products often need to be sold at a discount due to a perceived devaluation (Baxter *et al.* 2017). The customer is not willing to pay the same price for a previously used product if it is not of special importance such as collections, antiques or of emotional value.

Attitude barriers refer to the general attitude users may have regarding CE and sentiments towards the new system of consumption. The attitude barrier is closely linked to the acceptance factors introduced by Camacho-Otero *et al.* (2018) which are mentioned in the previous sub-section 4.2.1 (p 31). Individual perceptions, experience or social norms are among the influencing factors that can lead to a barrier towards CE. One factor is the trust in others when sharing a product or receiving one from a previous owner for further use. It also relates to the trust in quality offered by the provider of the product or service (Camacho-Otero *et al.* 2018). A lack of trust between the customers and between the customers and the providers can prevent full sustainable behaviour on the user side and, thus, their engagement in circular solutions (Hofmann *et al.* 2017). Furthermore, the potential complexity and complication with alternative consumption models bring with them the fear of unspontaneity and inflexibility influencing the users attitude (Gullstrand Edbring *et al.* 2016). Questions may arise if the product will be available immediately when needed when it is shared with others. Or, if it will be in good shape when taken over from a stranger (Camacho-Otero *et al.* 2018). Part of the attitude barrier is also the attribute of ownership present in the current consumer culture. According to Gullstrand Edbring *et al.* (2016 p. 6) "the institution and social norm of ownership is one of the main obstacles" to sustainable consumption. Users feel a stigma related to second-hand products or sharing instead of owning. Isenhour (2010 p. 463) states that modern societies "build [their] identities around symbolic objects that strangers can easily understand – possessions" as they "signal belonging, mutual understanding, and adherence to shared societal norms and cultural logics". The structures of society influence the attitude towards a new or different system that challenges the norms and a new consumption system might not be accepted if these values cannot be met.

5 Illustrative case study

This chapter introduces the recycling mall ReTuna which has implemented a local circular solution in Eskilstuna in Sweden (section 5.1). The key results from the expert interview and its relevance with the role of businesses and customers and the barriers they can impose are presented in section 5.2.

5.1 ReTuna Återbruksgalleria

ReTuna Återbruksgalleria (short: ReTuna) claims to be the first recycling mall in the world (ReTuna 2018). ReTuna is located in Eskilstuna in the county of Södermanland in Sweden which has around 105,000 inhabitants (Eskilstuna Municipality, 2019, 1). The mall is located right next to a recycling centre where people can drop off products they do not use or need anymore such as bicycles, furniture or any other product that is more than normal household waste. As is common in Sweden, the dropping off recyclable materials or also electronic waste is for free. The one who wants to dispose of any product of that sort can do so in the recycling centres around town. At the recycling centre the products are sorted into different containers based on the material they are made of. For example, there is a container for white electronics such as fridges, a container for wood or a container for grass clippings.

ReTuna opened its doors in 2015 and has since become known worldwide. It is a working business model which generated SEK 11.7 million (ca € 1.1 million) in sales for recycled goods in 2018 (ReTuna 2018). ReTuna is run by the municipality-owned company Eskilstuna Energi och Miljö (EEM). The recycling mall is financed partly by tax money but also by the profits made from selling the products and, thus, the shop rent collected from the tenants present at ReTuna (Pers.com., Bergström, 2019b). When the EU decided to introduce a European wide framework on waste management aiming to reduce waste the idea for the recycling mall developed. In 2012 the decision was made to build ReTuna (Pers.com., Bergström, 2019b).

The uniqueness of ReTuna lies in the overall recycling concept. The recycling mall is located right next to the drop off site only a few meters away from the recycling containers. Those who want to drop off their waste usually arrive by car as larger products are more convenient to be transported that way. Upon arrival the person can decide to pass by the goods receiving area of ReTuna instead of going straight to the recycling containers. If the person decides to do so he or she can drop off anything they consider reusable or 'refurbishable' at ReTuna before continuing to the recycling containers with whatever more waste they might have. According to Bergström (Pers.com., 2019b) everything people decide to leave at ReTuna at the goods receiving area is accepted or, in other words, nothing people bring is rejected.

After the product which can be anything from a bike to a dresser, clothes, toys or a TV, has been dropped off it is pre-sorted in the first sorting area by ReTuna staff. The staff sorts the received products roughly into what is considered reusable and what is not useful because it is too damaged. After this rough sorting the tenants of ReTuna chose what they want to use. The tenants are the ones running the shops in the recycling mall. They refurbish, redesign and upcycle what people bring to ReTuna. Once the tenants decided which products they want to repair, convert or reuse they go to work in their working area until they put their new product up for sale in the shop. The recycling mall has a shop for bikes (ReBuyke), for electronics (re:Compute-IT), some shops for clothes and design (e.g. ReTuna Design or ReModa) but also shops for decorative items or furniture (ReTuna 2018). For a break during the shopping the

customer can sit down in the Returama café which has tables made of old tires and the menu written on what was once a cars door.

5.2 Results of the expert interview

Regarding a practical example of a, at least partly and locally implemented, circular economy, ReTuna is a great business case. The expert interview revealed, however, that when starting such a business several issues occur that can influence and complicate a smooth implementation of a business with a new and circular business model.

One factor challenging a smooth implementation mentioned by Bergström (Pers.com., 2019a) is to find the right people to work with. In the case of ReTuna the main issue was finding the right tenants. The tenants renting the shops in ReTuna need to have the general mindset of sustainability and supporting the business model of refurbishing and up – or recycling on the one hand. On the other hand, they need to have an entrepreneurial mindset aiming at selling as many of their products as possible to a good price that makes them able to live from it. As the tenants pay rent for their shops they need to finance that as well. According to Bergström (Pers.com., 2019a) it was, and still is, not easy to find people who impersonate both the sustainable and the entrepreneurial mindset. Furthermore, one prerequisite for a potential tenant to open a shop at ReTuna is that he or she brings a clear business plan with a specific product or product group to be refurbished and sold. It is not wanted that there is a shop that sells everything from toys to lamps to clothes but rather specialize in only one product. As the mall is intended to grow further the search for tenants continues.

Another factor influencing ReTuna's success are the local suppliers and the customers. The business model depends on the people in and around Eskilstuna to drop off their products at ReTuna before continuing to the recycling containers. It is voluntary to stop at ReTuna and give what they consider reusable to the staff in the goods receiving area. However, as recycling centres and containers in general are well established, the trip to bring their waste there is quite normal for people. ReTuna receives a large variety of products the tenants can use and reuse or upcycle. The customer is another player at ReTuna. According to Bergström (Pers.com., 2019a) "it is not so often that it is the same people who are here [at ReTuna] to drop off things and then come inside and do some shopping". The ones leaving items at ReTuna are cleaning out their homes, wardrobes or gardens. Whereas the customers are there to shop or at least stroll the stores which causes other issues. Many customers expect low prices because the products sold are recycled and had been owned by someone before. On the other hand, they also expect high quality and creative ideas. Bergström (Pers.com., 2019a) stated that ReTuna has to compete with low retail prices that might get their products from cheap labour markets in Asia whereas ReTuna tenants work with and in the high-priced labour market in Sweden. The price expectations the customers have with regard to remanufactured products do not always fit the real labour prices at ReTuna.

In the case of ReTuna the local politicians, the municipality and the media have been huge enablers to get the recycling mall started. The municipality and the politicians were trying to find a way to treat waste as a resource as demanded by the European waste framework directive. The result was the business model of ReTuna. The general logistics were already there, the concept of recycling centres and containers well established and the space available near town. In the beginning especially the local media such as the radio or the TV covered many stories about the concept, the business and the success of ReTuna. Soon the novelty and uniqueness were picked up and spread by national and international media attention. A video published by the BBC in January 2019 has since been viewed over 78 thousand times (BBC, 2019, 1). And although there is nor the one single academic definition of CE, the practical example of ReTuna allows for an easy understanding of the idea and its spreading (Pers.com., Bergström, 2019a).

6 Analysis

This chapter links the theoretical framework of circular economy with the literature review and the illustrative case study results. Section 6.1 compares the business and consumer barriers and section 6.2 analyses the intersections of businesses and consumers in a circular economy.

6.1 Relating user and business barriers in a circular economy

The user is given a central role in the transition towards a CE and the businesses responsibility increases to allow for more than one lifecycle for their products. Circular economy has become a term of general use and although there is not one specific definition it is present in many academic as well as non-academic discussions. Where people are aware and active in increasing sustainability circular economy has become a common ideal. The concept is not without criticism but businesses, policy makers and consumers perceive it more and more positively. However, literature research and the expert interview have shown that the conditions for a successful broad scale implementation of a circular system are not ideal yet. Many obstacles need to be removed before or along the way in the implementation process.

Barriers for businesses are grouped into governmental, economical, technological, knowledge and skill, management, infrastructural, culture and social and market issues. User experience barriers as product use, knowledge, infrastructure, economic and attitude related. Figure 15 is a contrasting juxtaposition of the user and business barriers as found in literature. It shows the barriers identified by both stakeholders which are economical, knowledge and skill, infrastructural and cultural and social/ attitude related.

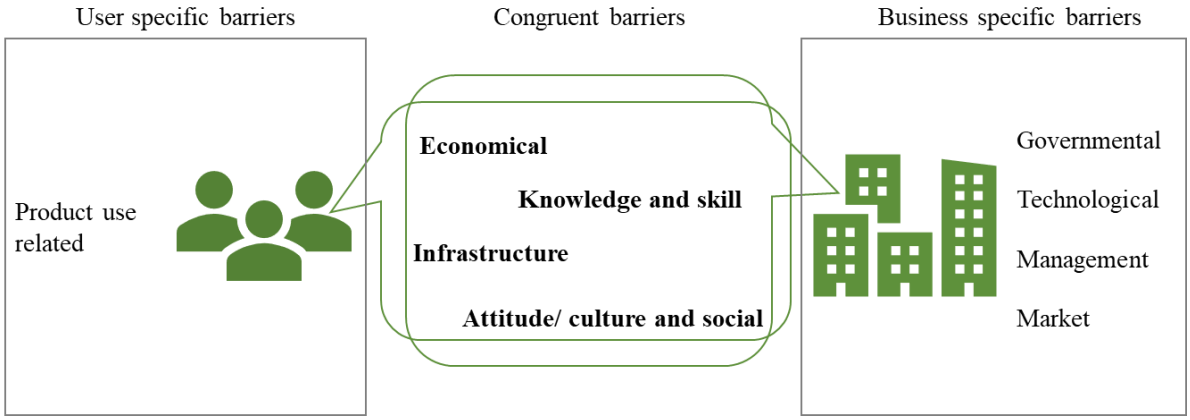

Figure 15. Juxtaposition of user and business barriers.

Economical barriers exist on both sides. The businesses fear the high investment costs, the potentially low return and profit and the difficulty in establishing the correct price for a reused, recycled or remanufactured product. The users on the other hand are not willing to pay a higher price for such a product but on the contrary tend to expect a reduction as the product has been used before. Both sides also see barriers in the knowledge and skills they have or that are needed in a CE. Potentials improvements for a CE remain unused due to ignorance or inexperience. Something similar is true for the users. Little information is available to the broad public on how a CE works, where and how one can participate and what benefits exist. The education about waste separation, recycling or sustainable consumption is very low. As the everyday user might well be the next business employee a relation between the lack of knowledge and skills might exist.

Infrastructural barriers are also to be found with businesses as well as users. Businesses see obstacles in the logistics that need to be built to handle return flows. In the global supply networks it is seen as difficult to account for all sub-suppliers. The existing infrastructural system with roads, energy grids and supply routes further complicate a change to CE. For users the infrastructure imposes a barrier regarding recycling opportunity, the convenience related to the disposal process and the effort involved to finding a sustainable or circular product (e.g. second-hand store, car sharing). The business barriers referred to as culture and social is close to the attitude barrier the users experience. The scepticism towards a new way of consuming and producing is present in the working as well as in the private environment. Both parties experience trust issues with other businesses or other users when sharing a product respectively. Further, what businesses perceive as a lack of consumer demand for circular products can possibly be explained by another user barrier: a desire for ownership, a fear of hygiene issues and low-quality expectations.

The Ellen MacArthur Foundation (2013b) has pointed out the need to rebalance the educational system to allow for a system change to appear. The knowledge and skill barrier seems to relate directly to this. The barrier can be seen as a root to success or failure of CE. The EMF emphasises the need to synthesise beyond pure analysis. Businesses and user have both identified a knowledge gap but it is not yet being acted to fill it. The EMF refers to the need to think in systems and understand skills and knowledge in a wide context. Sometimes adjusting or adapting is the solution to a problem instead of a simple fixing. The results from literature as well as from ReTuna show that there are overlapping problems for businesses and users. Both seem yet unable to take their full responsibility and drive a CE transition phase. The EMF sees the user in the centre of attention in CE but the results reveal the difficulties with that. The users are not yet prepped and prepared to fill that role. The processes to use any of the R strategies regarding reuse, remanufacture, or recycling, among others, are not available to be fully used. User, hence, lack opportunity and experience with the new system. The same is true for businesses who have few chances to change their system and still survive in their current market position.

Figure 16 shows the factors identified at ReTuna and how they can be sorted into the selected barrier categories. The barriers mainly acting at ReTuna are economical, attitude and market related.

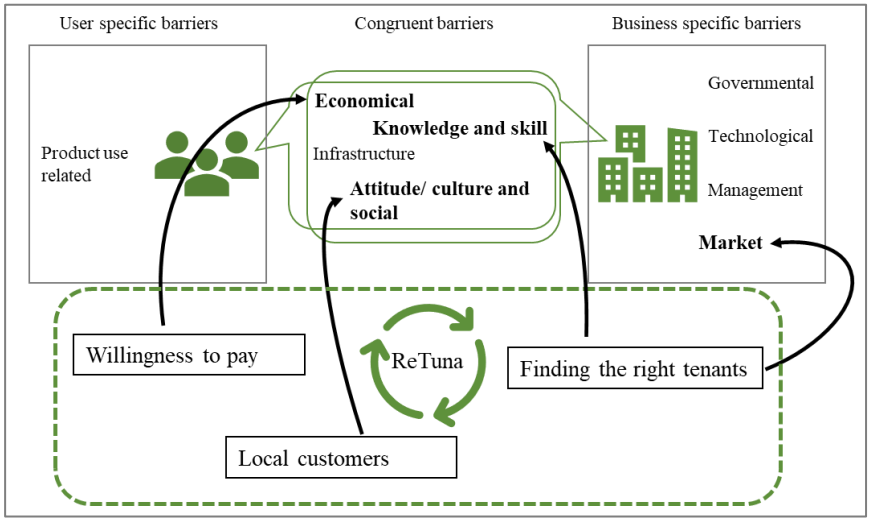

Figure 16. Hindering factors identified and categorised for ReTuna.

The illustrative case study and the expert interview deepened the results from the literature review. No entire new barrier was discovered but additional factors nuanced the market barriers in the practical example: The problem of finding the right tenants to rent the shops at ReTuna can be sorted into market issues on the business side (Figure 16). The market does not provide for many options for remanufacturing and remanufactured products. Finding the partners to establish a circular solution with and who have the drive for sustainability and an entrepreneurial spirit at the same time is difficult. Furthermore, this is also a matter of knowledge and skill. People do not yet seem to know how to bring together their business knowledge with a needed skill for circular solutions or vice versa. The right tenants might be available but do not yet know that they can participate in local CE solutions or how. Regarding the customers' acceptance of ReTuna recycling mall and their willingness to pay for the products there, these factors can be sorted into two categories. The former belongs to the attitude barrier in which the customers need to get to know the concept, learn about it and accept it as a place to shop at as in any other conventional store (Figure 16). The latter is an economical barrier as customers are not always willing to pay a price including the Swedish labour costs included in the refurbished products (Figure 16). The user related obstacles ReTuna faces are in correlation with the literature findings and confirm them.

6.2 Intersections of businesses and users in a Circular Economy

The EMF explains CE as a connected and feedback driven system. In this system, close interactions, cooperation and communication are of high relevance for success. As businesses and users are two important parts of that system their interactions and intersection at different stages is, thus, important. Both play a role in all steps along the supply and consumption loop. However, the way in which they influence or are influenced by production, distribution, consumption and return, whether as waste or for reuse, of a product differs. The businesses in their role of being parts manufacturers, product manufacturers and service providers take the lead in production and distribution processes. Once the user makes the purchasing decision and consequently buys a product the lead is transferred to the user. Figure 16 places the barriers found in the context of CE intersection of users and businesses.

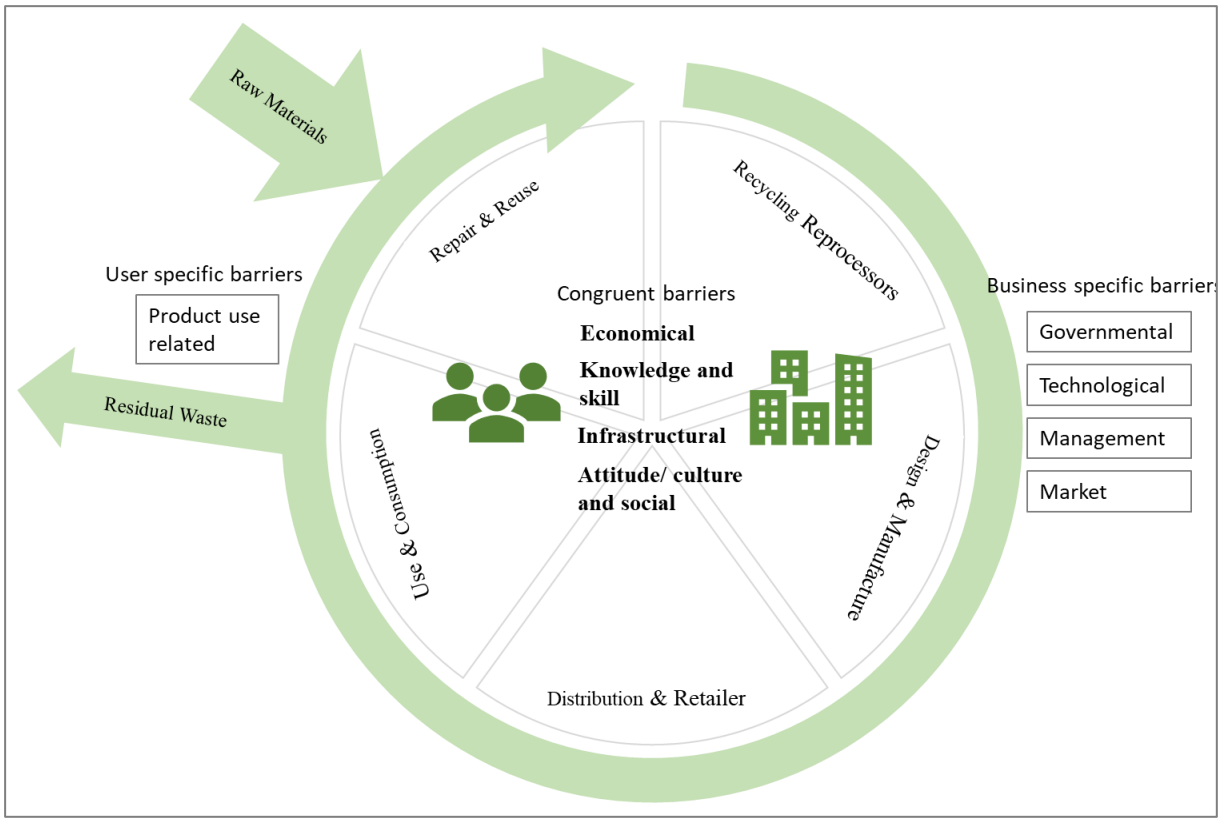

Figure 17. Business and consumer intersection in a model for circular economy.

Figure 17 shows that, firstly, businesses have the lead in a CE environment from 'recycling reprocessors' and 'design and manufacture' until 'distribution and retailer'. Business barriers act the most in these fields and the businesses' responsibilities to enable CE is high. Businesses in their lead during production and distribution need to design appropriately and reclassify their materials in their interaction with the user to support their participation. At the same time, the business barriers occur mostly during this part of the supply loop making it difficult for the businesses to do so. Designing a product in a way that it can be used in more than one lifecycle is of high importance. This refers to a "future proof design, design for disassembly, design for maintenance and design for remake and recycling" (Wastling *et al.* 2018 p. 3). This is, however, also where the technological and the managemental barrier cause the most difficulties on the business side. Assuring quality when designing with or from renewable or reused rather than virgin materials is a major issue in production.

Supplying production sides with renewable energies rather than current fossil fuel based is a challenge. The infrastructural barrier regarding energy supply with new or changed pipes and a changed electricity grid needs time to be overcome. From the management perspective this is a first opportunity to lead the business to a circular production if such an attitude exists as a first condition. To become fully circular, the business needs to use also what other companies produce as waste products, use what customers send back as reusable products and change their international supply network either to a local one or manage it sustainably. The identified sustainable or circular business models together with internal changes towards circular production and value chains can support this development. Accounting for all actors and processes along the current supply chain, however, needs transparency and action by all involved stakeholders but also by other enablers such as governments and policy makers. The distribution stages in a circular economy demand from the business to have a working return system, reverse logistics, in place. This imposes a huge infrastructural challenge for businesses

since this is not yet a common scheme. In a linear economic model and especially in a global supply network this has not been of major interest.

The infrastructural barrier has a great effect at this stage and also product design plays an important role again. Especially with modern electronic and electrical products repair becomes rather difficult or expensive; particularly regarding self-repair. Changing the battery of a modern phone or a tablet is hardly possible for someone with little or no technical equipment and knowledge. Another example is the changing of a light bulb in a modern car. Which was relatively easy in earlier models even for a layperson has today become nearly impossible due to the setup. Luckily, this is not a reason to dispose of the car as a task that simple can easily be solved by a car workshop. It could be suggested that the more expensive or complex the product becomes the less can be repaired at home and the less the current product design aims for repair or reuse. An appropriate design that has the users needs in mind and allows for easy participation in CE is needed to involve users and enable them as active CE participators.

Users take the lead and main enabling responsibility during 'use and consumption' and 'repair and reuse' (Figure 17). The responsibility for reclassifying materials to design out waste, allow for reuse and participate in alternative consumption models is now theirs. Furthermore, to design out waste, the user can follow the waste hierarchy in one way or the other from preventing waste as the most favourable option to recycle at the least. Alternative consumption models such as sharing or second-hand consumption create either new interaction points or a direct contact. Regarding collaborative consumption the relationship between the company offering the service and the user using it becomes closer. The business is demanded to ensure or create trust into the sharing model and into their ability to provide the service whenever the user demands it. Therefore, the businesses need to become more service and user oriented. When taking car sharing as an example, the interaction between user and business is direct. The user rents, in most cases, directly from the service provider, the owner of the car. If any damages or errors occur, the user directly addresses the service provider. The user also expects the service provider to make sure that all safety regulations, regular check-ups and mechanical details such as tire pressure, are taken care of by the service provider. The user needs to be in the centre of attention and business strategies rather than at an end.

Acceptance of users for new, in this case circular and environmentally friendly, solutions increases with experience, transparency, their involvement and information: For example, people who have lived close to a source for renewable energy, e.g. a wind energy park, are more likely to accept living close to one again as compared to those who have not (C.A.R.M.E.N. e.V. 2017). The same is true for conscious food consumption where knowledge and information influence how much attention is given to the quality and origin of the product (Mancini *et al.* 2017). Also with regard to sharing, studies have found that those who already participate by, e.g. renting their homes for holidays, have a positive attitude towards co-owning or product sharing (Gullstrand Edbring *et al.* 2016). This suggests that although it will take some time, the users' attitude can change with experience of using or practicing a new way of consumption. Therefore, errors can occur in the beginning when businesses and user act in a more direct way but with information and communication users can be convinced to participate in environmentally friendly solutions.

Waste management is a key concept in CE. Not only because with an increasing world population come increasing amounts of waste but also because waste becomes a potential resource. For both, businesses and users, this might be their newest or so far least noticed point of intersection. However, in a circular economy the responsibility for users and businesses

increases, especially regarding the waste management process. As Table 3, p 22, shows, the consumer can recirculate a used product by using any of the R`s (e.g. reduce, reuse, repair, refurbish, etc). Whereas the first R's of refuse and rethink might not affect the businesses in this particular part of the supply loop, the other R's most certainly will. If users refuse to produce waste and find alternative uses for their alleged waste product, it will have little effect on the business supply chain. Waste management is a key challenge for businesses in a CE as it has not gotten the utmost attention in the current system.

The factor of convenience becomes important regarding business and user interaction also. Giant online sales companies promise next day delivery for products manufactured by exploiting natural resources in a linear economic system. Any sustainable, circular sales concept and initiative competes with these convenient, quick deliveries. Many consumers have become used to the "promptness" of receiving what they want, to the flexibility of buying whenever they want and getting it shipped almost to wherever they want. Hence, a system that tries to compete with that needs to consider the convenience the consumers have become used to. ReTuna is an example how, in the transfer phase between a linear and a circular economy, waste can be treated as a new resource. ReTuna lowered the infrastructural and convenient barrier for consumers. By giving the consumer a choice as well as a convenient opportunity to dispose of their waste either in a circular manner at ReTuna or at the recycling containers the barrier is lowered.

Accenture (2019, 1) has found five business models supporting CE: circular supplies, resource recovery, product life extension, sharing platform and product as a service. In the practical example of ReTuna, two of these models can be seen active in a CE environment. ReTuna recovers resources and extends product life by reusing, refurbishing and remanufacturing part or products to give them another lifecycle. ReTuna reclassifies what is considered waste by accepting almost all products they receive, sort them carefully and make a conscious decision of how to further use them. Nonetheless, not all materials and products can be further used due to a high level of damage or the lack of a tenant who wants to or can reuse it (Pers.com., Bergström, 2019a). By closing the resource loop on a local level, ReTuna moves from a sustainable business towards a circular business. ReTuna, thereby, follows the business models suggested in literature that are favourable for CE implementation. However, ReTuna has no account on the production or the ways a product follows before coming to ReTuna. It is a business in the possible transition phase of an entire economy from linear to circular solutions beginning with a few possible actions to reduce environmental impacts, introduce circular flows and manage waste differently. The users who drop off their products at ReTuna make a first step in taking responsibility for reclassifying materials. Whether that happens out of pure opportunity, educated decision making, environmental consciousness or convenience is an open question but the beginning is made. This example shows that once single business can well begin and act in a more local circular context. However, the interdependencies of upstream processes and the complexity of global product flows call for other to follow the ReTuna example. Their implementation of circular business models could lead to a network of sustainable businesses. ReTuna can only be the beginning

Success is also company dependent where circular decisions need to be made by the leaders which then have to be followed by the entire company. To create a system that is "restorative or regenerative by intention and design" (EMF 2013a) the internal company structure needs to allow for several R's (remanufacture, refurbish, etc) to be enabled. It needs to incentivize a circularly suitable product and process design, knowledge, skill and understanding throughout the company, the supply chain and with the customer. The barriers found in literature and at

ReTuna show that barriers acting and interacting on multiple levels in a transition phase are difficult to overcome. Both, businesses and users, can, however, influence and support each other by overcoming them. Users demanding a circular way of product treatment create an incentive for companies to change accordingly. At the same time developing products and infrastructural processes that speak to the convenience desire of users regarding circular solutions is in the hands of companies. Ghisellini *et al.* (2016 p. 12) state that a CE needs a "balanced and simultaneous consideration of the economic, environmental, technological and social aspects of an investigated economy, sector, or individual industrial process as well as of the interaction among all these aspects". This is a complex demand for change on a large scale. It touches the small decision made at home when disposing of a product or large decisions when a company leader wants to implement reverse logistics which effects entire infrastructural systems.

This work focuses on business and user interactions in CE. They are inextricably linked. Balancing all the aspects of economic, environmental, social and technological relevance for businesses and users is a huge challenge. However, the demand for change, as complex as it might be, needs to be followed by action towards implementation. To enable a less troubled intersection of the users and businesses they have to work together closely. A relationship based on trust needs to be established as well as rules to be followed by both. The users lack trust in sharing goods or second-hand product quality. ReTuna, as an example, has solved this by offering guarantees on the electronical products. Companies lack a consumer demand and a market for the goods as well as the infrastructure for reverse logistics. The example of ReTuna shows that it is possible to solve the logistics at the same time as solving the market issue by offering something unique and lead a practical CE example.

7 Discussion

This chapter critically reflects upon the work of the thesis. Section 7.1 offers an insight into critics on the general circular economic concept. Section 7.2 discusses the results of the literature review in chapter 4, the results presented in section 5.2 and the analysis in chapter 6. Section 7.3 critically reviews the used approaches and methods which are described in chapter 2.

7.1 The circular economic concept

The concept of circular economy is not universally without criticism. Korhonen et al. (2018 p. 41) list six groups of limits for CE: thermodynamic, system boundaries, physical scale of economy, path-dependency and lock-in, governance and management and social and cultural definitions. The thermodynamic limits refer to the fact that even circular systems consume resources and create waste which largely refers to the biological materials mentioned by the Ellen MacArthur Foundation (2013b). Regarding the technical materials, it can also be said that not every product, however well designed, can be used endlessly or might need replacement if accidentally destroyed, e.g. by a fire. System boundary limits tale into account that in the short run non-renewable resources and energy sources might be needed to build a long-term renewable infrastructure. A transition phase needs to take place.

The limits due to the physical scale of the economy refer to the way economies generally work including rebound effects. In any economy, the increase in economic efficiency eventually leads to a decrease in production costs which decreases the end-product price causing an increase in demand. According to Korhonen et al. (2018 p. 43) when looking at CE success the "global net sustainability contributions of CE" need to be considered not just the local implementation. Thus, a working CE system in high income countries might, considering the current and future world population increase, not absorb the unsustainable economic systems in low income countries with increasing product demand and consumption. If primarily linear systems with all the draw backs of pollution, resource exploitation or 'throwaway mentality' are installed, a working CE in high income countries will hardly be able to balance that.

Path-dependency and lock-in limits refer to businesses that are successful and superior in the current system and will most likely stay in that system rather than adapt to a new model or technology. They will "hold their ground" (Korhonen et al. 2018 p. 44). The limits of governance and management include the issues of responsibilities and leadership in an intra-organisational and intra-sectional management and with material flows which are necessary in a circular economy. Assigning a leader and finding a common business strategy with many different stakeholders and general interests can be difficult. Social and cultural limits, as a last general CE limitation, are imposed by the different perceptions and definitions of waste in general which is a changing and dynamic concept. It is defined by an individual or a society, a nation or a global understanding. Therefore, it can be difficult to categorise and apply a concept of waste management in the global supply network.

A transition phase from one system to another takes time and patience which might, regarding the already visible impacts on the climate and environment, be difficult to allocate. Furthermore, it needs active participation of all stakeholders. However, Kirchherr *et al.* (2018 p. 264) state that "circular economy is a niche discussion among sustainable development professionals at this stage". This suggests that the great momentum and attention CE might cease if it does not get beyond the academic stage and attention. Nonetheless, Bergström

(Pers.com., 2019a) argues that although the customers at ReTuna might not know the term or definition of CE they might still be able to describe the general concept, how it works and perceive it positively. It is probable that the idea has reached interest groups outside the sustainable development professionals but without using the specific terminology. This is a needed and favourable development for CE implementation.

On the one hand CE is defined as a holistic concept that needs to take all stakeholders into account and act on all levels of production and consumption with waste management and closing waste and resource loops as key elements (EMF 2013a). On the other hand, several authors point out that CE discussion, action or policies very often revolve mainly around the issue of waste (Ghisellini *et al.* 2016; Kirchherr *et al.* 2017). The holistic concept and system feedbacks are, thus, not considered in the policy making. Furthermore, the existing waste policies have shortcomings beyond the lack of holism. Although the EU Waste Framework Directive has shed the light onto the waste management of the member states of the European Union, criticism, also regarding the development of a circular economy, has arisen. Gharfalkar *et al.* (2015 p. 306) state that the definition of the WFD (2008) disregards the role of "waste as a resource" and propose a 'hierarchy of resource-use' rather than a waste hierarchy. Similarly, Park and Chertow (2014 p. 47) point out that instead of seeing waste as just a danger to public health and safety waste should be seen as a potential resource "until shown otherwise". Within a system where human consumption transfers resources into waste the resources should be redirected back into the production process (Zaman 2014). If the goals, processes and actions are not clearly defined from the policymakers, the need pointed out by Wagner (2013) for clarity on waste handling for the user is ignored. Thus, the users' participation in CE is further aggravated.

7.2 Business and user enablement or restraint?

This thesis offers a wider understanding of the intersections of important parts and actors within the CE system by contextualising literature from different perspectives and it presents the shared interests between business and users. The results from the literature review and theoretical perspective showed the complexity of the topic and the importance it gets in the academic as well as practical research. Many authors have researched and analysed the perspectives of either businesses or consumers/users' but rarely have they been put together. The results suggest that businesses and users can both be enabler as well as obstacle for each other. On the one hand they can enable each other with a supportive infrastructure and product design that allows for easy repair, reuse or recycling (Wagner 2013; Camacho-Otero *et al.* 2018). On the other hand, users do not trust refurbished products or even each other when participating in collaborative consumption models. Furthermore, low virgin material prices lead to a lack in user demand for circular products. Therefore, businesses are reluctant to produce such products fearing high upfront investment costs and stay in the linear economic system (Kirchherr *et al.* 2018). Thus, the users that are willing to pay more for CE products have difficulties purchasing them in the little market there is. On the one hand, the example of ReTuna shows that once the business is established and disregarded or overcame the barriers, users are willing to participate and contribute to the success and profit of the business. On the other hand, education in the linear system with problem solving, closed and immediate cause and effect analysis and individual learning (EMF 2013b) limits the awareness, informational access and participation of users today and in the future. Today's participants in the educational system are tomorrows workforce that could lower the skill and knowledge barrier mentioned by users and businesses.

When defining the barriers businesses face in the transition towards CE the obstacles become visible. On the one hand, the governmental and policy barrier is defined as an obstacle by literature. The inadequate incentives and support and potential costs for change hinder businesses from orienting their strategies to become sustainable businesses (Ghisellini *et al.* 2016). On the other hand, practitioners research has shown that the governmental and policy barrier is less dominant amongst entrepreneurs. Pheifer (2017) argues that with an entrepreneurial background and drive one can be "successful in delivering circular business models with the current policy and regulatory environment in place". This could mean that the barriers suggested in literature, especially the governmental barrier, is of less practical relevance or used as an excuse by businesses for their inaction. The pressure of supply shortages of virgin material, the obvious quick change in the known climate, the costs for societies and people in the current linear economy are not enough to make their perspective and way of producing change. The global supply network has developed over centuries and although environmental problems are pressing, the resonance from those well established in the century old system is very little (Korhonen *et al.* 2018). It appears that, as political enablers tend to need relatively long to be decided on and become effective, businesses need visionaries to not 'hold their ground' any longer.

Another barrier often mentioned is the cultural and social barrier referring to a lack of enthusiasm, lack of consumer demand and cooperation. According to Govindan and Hasanagic (2018 p. 21) research shows that "90% of the industries do not have a good relationship within the industrial parks and other neighbour industries to establish eco-industrial chains". In a CE, businesses need to work together, form relationships with current competitors and develop either trust or strict rules. This means transparency and letting others look into the own production processes to access what waste produced by company A could become the resource of company B. But many industrial parks have failed (Sakr *et al.* 2011). On the other hand, ReTuna is a successful example and role model of what applied CE could look like. ReTuna understands itself to be part of the transitional phase from linear to circular and not a fully circular business. It is a very local application in a smaller town in one country. Nonetheless, ReTuna has overcome the barrier of consumer demand and enthusiasm. The recycling mall is profitable, well-known and well accepted.

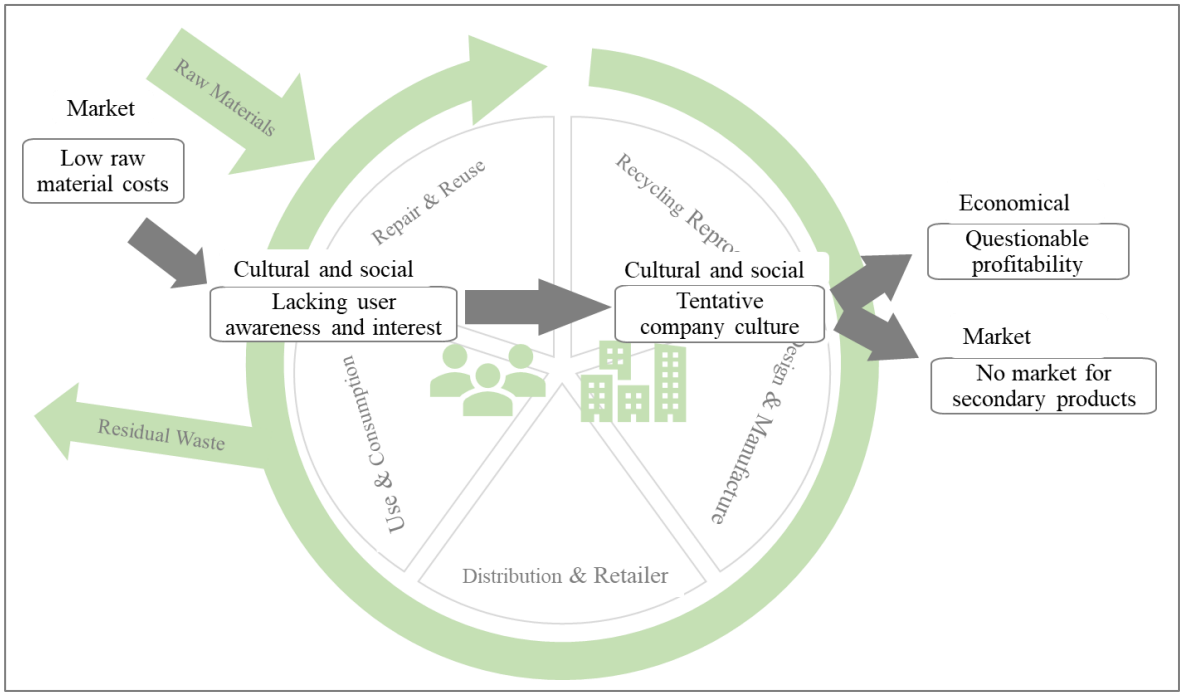

Figure 18. Chain reaction of business and user barriers.

Not only the economic system but also the intersection of users and businesses needs changing. The analysis has shown that the barriers for both are present and act on all stages throughout the circular economy. Businesses and users have several obstacles in common that prevent them from moving towards a CE more actively. Business and user barriers can even be mutually dependent as an example in Figure 18 illustrates: The low raw material costs leave circular products at a disadvantage as compared to conventional products. The higher costs for CE products lead to a lack of user interest in purchasing them, which, in return, causes businesses to be rather hesitant towards implementing CE and selling such products. This leads to the economic barrier of little expected profit and no market for secondary products – neither for businesses nor for users.

The analysis of the users' role in CE has shown that it is important to be acknowledged not only by the businesses but also by the users as a group and as an individual (Wastling *et al.* 2018). However, the question whether with this importance their influence increases remains unanswered. Literature often focused on the consumption behaviour when the solution is already emplaced or to be introduced. The user and the business work together in the linear system. As argued by Bergström (Pers.com., 2019a) the wish to behave sustainably does not necessarily lead to actual sustainable behaviour. Price and convenience play an important role in this context. The people visiting the ReTuna shopping mall do not always purchase a product. They vent their admiration or support for the concept but might leave without supporting the business with their money. It is not unusual to have a shopping stroll without the necessary intention to purchase. At ReTuna the many external visitors might spread the word of the new business concept beyond local boundaries. However, the locals are needed to drive the profit, as well. The analysis has not offered and explanation for this problem. Is it the price of the circular products? Was it not the right product? Was is the convenience of buying at the known, conventional stores? Would they shop if all shopping centres where recycling malls?

The EU action plan for circular economy was published in 2015 (EC, 2019, 2). In order to increase user participation and awareness, the European Commission wanted/wants to introduce a user-friendly labelling system that includes product information on environmental performance (EC, 2019, 2) but this might be a solution to a problem that does not even exist. A label would mean that the people know why it is important, understand its relevance and that they care. The action plan encourages member states to offer price incentives, use taxation for less environmentally friendly products and processes aiming for prices that better reflect actual environmental costs (EC, 2019, 2). However, McDonough and Braungart indicate that users are easily distracted and drawn towards "free of" products (2010 p. 166). Thereby, they argue, it does not always matter what the product is free of, whether that has any health or ecological relevance (McDonough & Braungart 2010). This indicates that it is not enough to label or certify a product if it is not understood by the user or consumer. The content, the relevance or impact need to be educated and informed about, too.

7.3 Approach and method

The framework this study was placed in was the circular economy model by the Ellen MacArthur Foundation (2013b). In this context a literature review and an illustrative case study including an expert interview were conducted. The EMF is a well-known actor in CE research and their model widely used. It is, still, a model aiming to simplify and visualize a complex system. It provides the boundaries for this work and ensures for the accountability of the analysis and context of the players focused on. The EMF model guided and structured this work and the research topics by providing the key CE principles. This work followed the idea of putting the user in the centre of CE but also shed the light on the closely linked business

interactions and business perspectives. As the model is complex only the technical cycle was used and further simplified for a better understanding and analysis this work was aiming for. Other models for CE exist but the Ellen MacArthur Foundation model includes the perspectives of the consumer and producer relevant for this thesis and shows their interaction points giving a frame to this work.

The literature review was conducted in several steps. First, the review was planned and search criteria defined. This provided for a structured search and gave a first overview over the topic. This allowed for defining some first delimitations such as the focus on a high-income countries context rather than globally to keep within the frame for this master thesis. Furthermore, it showed that for an insight on the business perspective a scope beyond academic literature was useful so the search was widened to practitioners sources. The next step was to conduct the research more deeply and use the SQ3R method. This gave a lot of results that had to be filtered and sorted. This was done thoroughly but information might still have slipped the filter. The sorting also showed many different definitions for CE exist. Thus, for this work a definition needed to be chosen or decided upon to ensure clarity but the author is aware that this decision can already be a potential bias. It also became clear that this topic and research area is complex and has grown over recent years. As the focus was laid upon two different perspectives the results were multiple. However, it could also be seen that the amount of research conducted on consumers and/ or users in the context of CE was visibly lower than for the business side. The same was true when narrowing down the research to barriers and obstacle towards CE enablement. The snowballing method was used and found useful to find more information on both perspectives. Starting off with often cited and well-established or known authors helped to get a general understanding and overview. The additional practitioners' sources provided a good insight into the actual business situation. It also allowed for some information about the business user interaction, practitioner research and barriers faced. The snowballing method relies on previous researchers and is a subject to bias.

From what was found the two perspectives could be understood. The barriers for businesses presented by Govindan and Hasanagic (2018) was chosen as a bases. Due to its level of detail and summary it provided a good overview. It was then adapted with what was further found in other sources. Regarding the users perspectives the general categorization followed the logic of Govindan and Hasanagic (2018) but was adapted to the actual barriers found for users. It also became clearer that the barriers for users where less researched or often based on a specific product, consumption system or was mentioned as a general barrier with a lower level of detail.

The illustrative case study was chosen to be ReTuna. ReTuna is a successful example of business and user interaction in a circular economy. The expert interview conducted at ReTuna presupposed a common understanding by the interviewer and the interviewee about the concept of circular economy. It was possible to go into detail and communicate on an expert level to identify barriers found in practice. The interview confirmed many barriers found in the literature review before but also identified a hindering factor that was not considered before. To get a larger variety of opinions and test the generalisability of ReTunas opinions more than one case and expert interview could have been good. Also, cases in different environments, cities or countries could have enlarged the applicability of this work. The author is aware that it is one single opinion presented in this work. The author is also aware that a successful case cannot speak for the entire system or parts of it. To get more insight into the users' perspectives survey or interviews with users could have been conducted. Both, more cases and user surveys or interviews were not possible due to the resource limitations for this work.

8 Conclusions

Considering the environmental destruction, resource scarcity, global population increase and increased waste production the currently dominant linear economy needs to be restructured or even replaced. The concept of a circular economy could be such a replacement. A circular economy aims at closing material loops so that products and components maintain a high utility and value. They are used through multiple phases and lifecycles. Waste is generally tried to be prevented where possible and treated or reused as a resource as much as possible. CE is about resource efficiency, circulating products, dematerialisation and sustainable production and consumption behaviour. A system change brings along several challenges to all actors in the system. This work examines the perspectives of businesses and user in a circular economy and the barriers they face. A literature review was used to gain insight into the perspectives of businesses and users and their role in a CE. The literature review included not only academia but also practitioners research. It was chosen to start with a general definition of keywords and search criteria before conducting the article search thoroughly to find as many relevant articles as possible. Nevertheless, it soon became clear that the number of articles that focused on the business perspective, product design or barriers businesses perceive regarding the shift towards CE was larger than the number of sources about the user perspective. The users' perspective, their place and importance in a central position as well as the obstacles they must overcome as actors in a circular economy is less represented in literature. Thus, the results were further backed up by a web-based search with additional practitioners' information on users and businesses. An illustrative case study was used for further information as an expert interview was conducted at ReTuna recycling mall for more details on business and user intersections and successful interaction in a circular manner.

The framework for the review and analysis of this work is the circular economy model as introduced by the Ellen MacArthur Foundation, a luminary in this field. The model distinguished technical and biological nutrients. Biological nutrients include products or materials which energy is extracted on each cascading stage being really consumed, such as food products. This work focuses on technical nutrients or products. These are 'hard' products that can be used rather than consumed in the original meaning of the word. The user can maintain, repair, reuse, refurbished or recycled (the R principles). Thereby, the more often the product can be prevented from having the fate of what is commonly understood as waste. Waste in CE is defined as a potential resource that can be used, upcycled or downcycled. Only as a last resort should a product be fully disposed of or destroyed and be used for energy recovery. In this closed loop system businesses and users play a vital role. Users design, form and establish the loops that are so essential for the circular concept. The consumer, or in a CE rather the user, is in the centre of the R's a product can be handles as. Businesses provide parts, materials or services from what they receive from the user. This is the framework in which this work places the perspectives and barriers for users and businesses.

In this framework the literature review conducted shows that businesses have many ways to participate and install circular solutions. Along their supply chain these include circular inputs, product design, process design and circular flows to improve and rethink their products and processes for a circular model. These circular improvements can be introduced in business models by changing to circular supplies, resource recovery, product life extension, sharing platforms or products as a service. One main recovery in this context is the need for a holistic point of view in the complex system of CE. In a CE the customer is not only a user but a valuable and relevant resource for circularity and cooperation and the business has to adjust accordingly. However, along with establishing circular solutions come challenges in form of barriers. The literature review and the illustrative case study of ReTuna find eight main barriers

for businesses: governmental, economical, technological, knowledge and skill, management, Circular Economy framework issues, culture and social and market barriers.

The other actor analysed in this work are the users. Users in a CE are confronted with new consumption models such as collaborative consumption, second-hand consumption and access-based consumption models. However, with these changes come along other factors that change the general consumer to user characteristics. Their consumptions will be defined through anonymity, connected consumption, multiplicity of values, political consumerism and uncertainty. Further, the attitude users take towards CE are defined by several factors such as personal characteristics, product and service offering, knowledge and understanding, experience and social aspects, risk and uncertainty, benefits, other psychological factors. The central role users take puts a certain pressure on them to act and ask for sustainable solutions but along come obstacles as well. This grouped them into the following: product use, knowledge, infrastructure, economic and attitude related.

8.1 Similarities between barriers for businesses and consumers

The similarities that can be found between the CE barriers for businesses and users, the first research question, regard the lack of knowledge and skill, missing infrastructure, the economic viability and the general attitude or culture towards circular solutions. Both sides experience a lack of knowledge on the business side regarding circular solutions and employee skills to implement them. Users lack accessible information about the concept, waste management or possibilities to participate. Thereby, the missing education for young people today can lead to a lack of skill on CE in the business and employees of tomorrow. Businesses and users both see a lack of circular economy supporting infrastructure as a problem. Businesses find it hard to implement circular solutions throughout the entire global supply network. The current infrastructure makes it hard for them to even apply local return logistics concepts because it is not yet destined for that. Users struggle with returning their still usable but not anymore wanted products in another way than bringing it to waste collection sides. Furthermore, conventional stores are currently far more conveniently located and well established. Second-hand stores of any kind are comparatively rare. The economic feasibility is a barrier for both actors when moving towards a circular economy. The prices for virgin materials are still at an acceptable price level for businesses to keep production costs low. The availability and prices for reused or recycled materials on the other hand is rather high due to the process costs involved. Additionally, the lack of a profitable market for circular products makes businesses question the profitability of CE solutions. User are used to the current price levels which are based on low virgin material costs. The increased costs for remanufacturing in with European labour costs or included environmental costs is less attractive and desirable. The barrier of attitude or culture was also mentioned by businesses and users. A CE is an almost unknown system where both sides experience scepticism, lack of interest, lack of trust and quality. Businesses state that the relations with neighbouring businesses is not good enough to establish a deeper relationship as basis for circular solutions and mutual benefits. Users fear a lack of quality in recycled products and the need for ownership is still widely spread. Both sides lack enthusiasm for shifting from a linear to a circular economy.

8.2 The nature of consumer and business interaction

The answer to the second question of ‘what is the nature of consumers and businesses interaction in a circular economy’ is that user-business-interaction takes place on all levels in a CE meaning in short production, distribution, retail and waste management. The interaction becomes closer and more direct as compared to a linear economy. One example is collaborative consumption in which the company provides a product, such as a car, to many users which share it amongst each

other. The ownership stays with the business and the business provides the service. Thereby, the relationship between user and business does not end with the purchase of the product. However, businesses need to install return logistics for the products the user brings back or new businesses, such as ReTuna, establish which sell what is brought for refurbishment, or else, by the user. One central question this work asks is how businesses and users interact in a CE. A case in which a business and users work closely together in a local circular solution is the recycling shopping mall ReTuna in Eskilstuna, Sweden. Recycling containers are installed close to the shopping centre. Anybody planning on recycling their household products from furniture to bicycles, toys and clothes can decide to, instead of throwing them into a container, drop them off at ReTuna. ReTuna takes the received goods, sorts them and then reuses, redesigns or refurbishes the goods to sell them to customers in the shopping mall. Although the customers walking into ReTuna are not necessarily the same who have just before dropped off goods, the concept has put down roots in the area, has been shown to be profitable.

8.3 Conflicts of interest between businesses and consumers

The third research question asks 'which conflicts of interest occur between businesses and consumer in the transition to circular economy'. On the one hand there are the users in a central position in a new economic system. Price is a key factor for active participation but prices for re-circulated products are, to this date, more expensive than conventional ones. The example of ReTuna shows that people tend to expect lower prices for second-hand goods because they are used. However, an upcycled bicycle or a kind of furniture remanufactured with, in this specific case, Swedish labour costs is not necessarily cheaper. On the other hand, there are businesses that want to make profit. For a CE, businesses very often need to change their business model. They need to produce for durability, repairability and resource efficiency. A purely profit oriented business model will not succeed under the principles a CE asks for.

Dematerialisation, rethinking consumption behaviour or refusing to participate in a 'make-use-dispose' dominated economy are key concepts for users in a CE. However, norms, status and societal pressures might need considerable strength from the individual consumer to become a sustainable and circular user and drive demand for circular solutions. Businesses need to leave their well-established comfort zone in the linear economy and aim for a new resource efficiency that allows for an unknown frugality in society to enable CE in their customers.

8.4 Future research suggestions

This work focused on only two players in a complex system and analysed them in the European context. However, it can be of great value both for academia and practitioners alike. It is one of few that compares, relates and analysis businesses and user perspectives and barriers. The direct comparison shows the similarities both players have and can enable researchers to develop solutions based on this. This work also groups and conceptualizes the user barriers and enriches existing literature with newly found barriers in the CE concept. Practitioners might take the case study results when developing a circular solution to use the identified barriers and challenges to learn from. This work makes no claim for completeness and the barriers were not validated by interviewing with another business. Therefore, additional research is needed to verify the findings of this work. Future research could be focused on the consumers perspective in the practical environment to better understand the actual and the perceived barriers. The future research should include consumer surveys or interviews to facilitate cumulative knowledge and holistic understanding. Future research could also focus on possibilities to empower trust and understanding in businesses and consumers respectively to form symbiotic relationships for CE implementation.

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Bergström A., June 2019b, ReTuna business presentation, Eskilstuna, Sweden

Appendicies

Appendix 1. Interview with Anna Bergström

Interview ReTuna – 11.06.2019 12:00

M. Eimannsberger: We signed the informed consent forms and I have to quickly go through this bureaucracy. I am doing my master thesis and I will use the information that you give me and transcribe the interview and send you a copy that you can say yes or no to or if I have to change anything. And the thesis will also be published.
A. Bergström: Okay.
M. Eimannsberger: Then we could start with you telling me a little bit about ReTuna. Where did the idea come from? Was is a spontaneous decision?
A. Bergström: No, I think this is just a reputation that I don't know whether it is true or not. Because when I started no one wanted to know anything about the ReTuna project. Because we are a municipality owned company and the politicians here, the local politicians, will give us the guideline how to handle all the waste within the municipality. And I believe that no one really believed in this idea. Because I think it was written as a suggestion for the municipality politicians in 2006 or 2007 and it comes from the common waste plan that we share within the European union. Every country should reduce waste and see waste as unused resources. And, also, to reuse became something that everyone should do. So, I think it was a green politician that came up with the idea and tried to make the local politicians to make the decisions to make something like this. I don't know what the idea looked like from the beginning but in some way the suggestion just was transported into some of the different kinds of municipality service men and women and around people who in a way have some power.
M. Eimannsberger: So it was brought to the decision makers?
A. Bergström: Yes, I think he was a good lobbyist in a way. So he just talked to the right people and right politicians and eventually in 2012 I think the decision was made. Then they started to begin this whole business and park in 2014. The recycling center outside is also part of the park. And also the mall. I think the business name is cycle park. And if you translate it to English it will be like bicycle park but that is not the point.
M. Eimannsberger: There was nothing here and you built it from scratch?
A. Bergström: The building was here but it was owned by the DHL. They had some storage here for big trucks.
M. Eimannsberger: And you opened ReTuna in August 2015?
A. Bergström: Yeah.
M. Eimannsberger: And the tenants they just came along?
A. Bergström: I tried to find them. This was not the tenants or business that you can find on google. They're in the basement doing something as a hobby or not commercially from the beginning. So, it was quite a big challenge to get the right tenants from the beginning. And I understood that these maybe won't last forever. But some of them who were here form the beginning and started up the business are still here. I think it is only two of them who were here at the beginning that have moved out. We had some new tenants of course and we also expanded the commercial areas. In the beginning we had a big exhibition area as well. We had an exhibition about circular economy but it was not many people who visited this. I believe it was too early for that. Today I would say people are more aware and know more about circular economy. I think also when people visit as a customer or just as a visitor they want to see the stores. That is their main goal. And then all the facts are more of a bonus that

you are more sustainable. No one has come here just to buy a new jacket that no one has worn before. That is not the reason they come. I think that has never been the reason.
M. Eimannsberger: A quick question about the recycling plant outside. Was it key to success that people can dispose of their waste next door? Or would ReTuna also work elsewhere like in an industrial park area? Is it important that people can easily access it?
A. Bergström: I think recycling people, people who work with recycling and waste they want to have this concept as a park. Of course, it is an easier way to see the practical example of being circular and also that we through away a lot of stuff. Everything is reusable. That is more or less the practical example. Of course, you can use empty areas that are already established in a city or shopping center to see how to make those stores more sustainable. I think that will be the future. This is just a way to get started. It will always be transportations. I think the stores have their own suppliers today. That will be in the future, too.
M. Eimannsberger: Maybe a little bit back to the origin again. What was the main challenge? Was their skepticism, was there criticism? Was the process slow and bureaucratic or were other companies afraid of you becoming their competition and a new power on the market?
A. Bergström: The main challenge was and still is to have the right tenants who are committed to save the planet. They need to be aware of sustainability and how to run a store in a sustainable way. But, also, that they want to make a living of their business. To have these in one person is not easy to find. But I guess there is a lot of people who want to make money and there is a lot of people who want to be sustainable and have a sustainable business of course. But to do it in an entrepreneur spirit and to do it really good - it is hard to find these kind of people. And, also, that all the visitors and everyone who comes here loves the concept. But just go from loving it to go to action and to shop that is still a big step. That is also a challenge to make this as cool as we say it is.
M. Eimannsberger: So, one of the main focusses of my thesis is how to convince the customer to become more sustainable and join these kind of concepts. How would you describe your relation with the customer? How did you convince them to come here and how did the relationship develop? Do they have the sustainable mindset or is it also curious passersby?
A. Bergström: That is still a struggle. I guess we have had a lot of help from media. I would say that already from the start the local paper was quite interested in what we were doing here. They made some articles and we have been exposed in media quite a lot. But maybe more outside Eskilstuna then inside. But in the beginning I had requests from the local radio, the local paper and they wanted me to be in networks with different kinds of businesses. Like in local business networks. But after a while I guess there was more jealously. I am not sure that is the right way to explain it. But more that we had this journey globally almost with the help of Rob Greenfield. I don't know if he is an influencer but he started this success on Facebook and reached a lot of people. And then the world economic forum was here and they made a film, too. That was published and viewed 25 million times. And then we had a visit from BBC and then everyone else who published articles both in papers and magazines.
M. Eimannsberger: And you also gave many interviews correct?
A. Bergström: Yes. I guess that is the way we basically said yes to all the requests and we have been working really, really hard. Of course, you need to have a relationship with the local people. They need to see if I am trustworthy and if the tenants here are trustworthy. If they are going to put their own money into their cash machine it need to be worth it. So, I guess people who live here they believed in us. But, also, still people have never been here. About 100.000 inhabitants in Eskilstuna and I would say that there is still people here who don't know about us.

M. Eimannsberger: But you did have an opening event and previous advertisement, I believe?
A. Bergström: Yes of course. And everyone was happy that day. And afterwards of course.
M. Eimannsberger: Circular economy is a really abstract concept. I guess there is some curiosity about it when people come here. But, as you said, there is a gap of being curious and acting on it or just talking about it?
A. Bergström: I wouldn't say that locals are very interested in circular economy. They are more interested in buying cheap things. So, I think that is the reason why people come here. But we also have different customers on the weekends and Monday to Friday. But, also, conference guests and study visit groups they are a bit different. Very often when they come from outside Eskilstuna they come from other cities but they work within the branch in some way. And they are very aware and ask about circular economy. The questions are different what we are doing and what we want to achieve or if they are here to do some shopping. I think the mainstream person who lives in Eskilstuna is not aware of circular economy but they can see of course how we receive things and what we do to these things. And what it looks like when we put it up for sale again. They know that this comes from someone else who has left it in the drop off area. I guess that is also a way of learning - just by doing or by just being here without having the perfect word to describe it. I guess more people would know what circular economy was if you asked them about ReTuna. They could explain the concept I believe. Because we are a practical example which is easy for people to understand.
M. Eimannsberger: And for the customer it is really convenient to first drive by the drop off and then they can go up to the containers and through away the rest. Is that important or would it work without the recycling facility as well? Would they drive the extra mile to get to ReTuna?
A. Bergström: Yes. It is not so often that it is the same people who are here to drop off things and then come inside and do some shopping. Because I think they are in the mood for cleaning and putting things in containers and I think that is brilliant and I love that this is how it is. If you feel like you don't need to be dressed for shopping but for cleaning to go inside here and were are not the trash shopping mall that you maybe heard about before. People what to be dressed properly.
M. Eimannsberger: Where there any obstacles or challenges in convincing the people to buy here? For example, you often read about prejudices about second hand whether it is hygienic, or broken or nor worth it or more expensive? Did you experience that?
A. Bergström: I think people are more suspicious about second hand. No one cares about how things were produced in a regular commercial shop, no one asks about chemicals or if it is poisonous for the skin, can I wear this clothes without getting scratches. But here they want to have everything that is already cheap they want cheaper and of course they want to know if this is a good offer for them. Some of the stores have guarantees as if you would buy a new product in a regular commercial shop. Such as the TV and electronics shop. Maybe not the three years as in the commercial shops. But often you buy things just the way it is. And I think the tenants are very transparent of how they take care of things and how they repair or how they upcycle. But anyway, it is hard to get a reasonable price for the product anyway. Because if you for example buy a new bike here I wouldn't say that 1000 SEK was too much. But people wonder why you could sell a bicycle here for 1000 SEK and also you can buy a totally new bike for 1000 SEK in another shop. I don't know if this old bike is too expensive or if the new bike is too cheap. I guess it is too cheap. We are so affected by the retail not having reasonable prices in general - All the Chinese productions and how we see and value all the materials. In Sweden we see working hours or crafts as something that has a value but not the materials. So, I guess that will be a challenge even for the future. If you don't have it anymore than it becomes valuable. But I think we need to go the whole road for example to

see how we handle water today. All of us know that we will have some lack of water in the future but this knowledge doesn't change anything.
M. Eimannsberger: Do you think ReTuna is the model for the future?
A. Bergström: Yes, this is the future way to run a shopping center. This model in different shapes you will see in Sweden and the world. I think in some way this will be a model for the future. There is no other option. We do it now for the changing period and we need to make money and are living by the market economy rules. But we do it in a circular way. We are the time between and we will be the role model how to change. Then we have other values than money of course we will be an example.

Appendix 2. ReTuna introduction speech by Anna Bergström

Guided tour introduction speech – 11.06.2019 12:30

A. Bergström: Everything is reused here in ReTuna. Outside you maybe saw the recycling center. It is a big area full of containers. Maybe that is something you recognize from home. Maybe you have a similar way of sorting waste at home. It is a big area with containers for different uses. One for, for example, plastic, one for wood, one for electronics and things like that. You just have your car at your house, pack what you want to get rid of and come here and sort everything that you don't want to have anymore. So that is what we usually call waste. It is for free and you can come as many times as you wish. That is different in different cities but in Eskilstuna we take everything. To avoid all these private small dumping places in the nature. So, it is better if everyone comes here. And what private people call waste here in ReTuna we call it unused resources. We try to make people drop off things here instead before they go to the recycling center to throw it away. And, of course, it is not only waste of course it is being used again for recycling which is the second-best option. The best option is to reuse it. To use it again. That is the best way. By doing this by creating a place for people to drop off things it be reused you will save and reduce waste for the whole municipality. That is a good thing for the environment. And to use things again instead of producing new stuff is a more sustainable way. Basically, I am the property owner in this role and the owner of all materials that people bring to us and then I supply all my tenants. That is the stores and all the businesses that have the commercial area or rent some parts of the area from me. I supply them with all kind of materials and then they will be the ones who sort a second time and also do the reparations or upcycling. And then they out it up for sale again. Often it is people who live in Eskilstuna that drop off their items and often the Eskilstuna people are also the customers. This is the practical example of circular economy. People drop off things and then come back to do some shopping and then they go home. And maybe after a couple of months they will come back to drop something off again. In this way we are the most sustainable municipality in the world. It is so easy. And I think that wherever you can find waste it is possible to do something similar of course. We accept everything the people bring us and don't refuse anything. If we decide we don't need what they brought after sorting everything we bring it to the recycling center. But waste is a very private thing. And if we refuse to accept someone's waste they might feel ashamed and not come back.
Question from audience: Do you have any rules?
A. Bergström: Of course, a lot of rules. Hard to follow for some and easy for others. But to be able to receive items you need to have a business plan, you need to have a contract for the commercial area with me and I need to see that the business plan is business like and professional. And that you have a big commitment for saving the planet and being sustainable. To be an entrepreneur and want to make a living of the business here. So, these two are the essentials. I can't take one or the others I need to have both in one person. And that is not so easy to find. But when you have your business plan that is the guideline for what you will receive for your store. That you don't have toys in one corner of the shop and then some TVs in the other corner. You need to define yourself. What kind of store are you. If for example you decide to be a lamp store then all the lamps we receive will end up with you so you can do whatever you want with those. This is a challenge because all the stores and the owner that actually do something to the products such as upcycling or reparation, will do better because the consumer loves that more if it feels like new. That is screwed up as we love to buy new things. The more work you put into remanufacturing the products the more profit

you can make. Everything outside ReTuna is too cheap and we are not willing to pay the price that it should be. We always want to buy cheaper.
Question from audience: What is the business model of the whole enterprise? In the United States we have to pay for recycling for hard to recycle items that people would like to find better lives than landfills for but it cannot really be resolved. So how do you handle the costs end if everything is brought here for free?
A. Bergström: The Swedish pay a lot of taxes and that is not for nothing. It is like an all-inclusive concept. So, you can go by bus quite easy and cheap and go to the doctor and also get rid of your waste. The recycling center and the drop off station is financed by tax money and all my costs, 20% of me is also tax money, because I have the mission to be informative to the people who come here and tell them about sustainability. Also, to make people living in Eskilstuna more sustainable and how to live a more sustainable lifestyle. But the commercial area is paid by tenants. So, my income is from rent and their income is from saving and selling the product that I have delivered. Theoretically this is a brilliant business model. As long as products are sold. To a value that is reasonable. But that is also the challenge. So, I said to the head of the municipality how could you send me on a mission that will not be successful? You have small children just creating more waste and I am supposed to reduce the waste in the whole municipality. And he said that I got a point there. You know, all the things that the kids bring home just a bunch of garbage that you can't sort, what they create. That is not the way we work here. Teach the children for the future. Like the kids bring home drawings or a Santa made of all kind of materials. You save it because you want to be nice. But I think that we could do good things from waste. We raise our kids to take something new, its ok, take something new. And then we just discover that we have created little monsters. We need to change that.

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